EFFECTS OF STUDY SKILL TRAINING AND CONCEPT MAPPING ON STUDENTS' ANXIETY AND PERFORMANCE IN BIOLOGY

BY

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DECLARATION

I hereby declare that this thesis has been written by me and that it is a record of my own research work. The sources of information are specifically acknowledged by means of references.

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CERTIFICATION

This thesis entitled "**EFFECTS OF STUDY SKILL TRAINING AND CONCEPT MAPPING ON STUDENTS' ANXIETY AND PERFORMANCE IN BIOLOGY**" by Augustina Nwamaka Chude (Mrs.) meets the regulations governing the degree, Master of Education of Ahmadu Bello University, Zaria, Nigeria, and is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This work is dedicated to my dear husband, Dr. V.O. Chude and my five children: Chibogu, Chinedu, Chinwe, Chinonye and Chukwunonso, whose love, patience, understanding and encouragement sustained me when I got discouraged.

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ABSTRACT

Test anxiety has been shown to have a negative effect on academic performance of science students. There is therefore a need to create an anxiety free atmosphere for effective learning of science to take place. Previous related studies could not proffer solutions to the problem, possibly due to the use of inappropriate experimental designs. In this present study a more pragmatic approach was adopted The effects of study skill training and concept mapping strategy on students' test anxiety and academic performance in Biology were tested. One hundred and thirty-nine SSHI Biology students of F.G.G.C., Zaria were used for the study. Two instruments were used for data collection: Test anxiety was measured using a version of Zuckerman's (1960) Affective-Adjective Check-List; while Biology achievement was measured using multiple choice items selected from past WAEC questions in Biology. The data collected were analysed using t-test, analysis of variance, and Duncan Multiple Range test at 5% level of significance.

The results obtained revealed that both study skill training, and

concept mapping strategy reduced test anxiety and improved academic performance, although better academic performance was obtained from concept mapping. However, the combined strategy of study skill training with concept mapping was found to be most effective in reducing test anxiety and improving academic performance; but this was not found to be significantly different from the effect of concept mapping strategy. These two methods can therefore be used interchangeable as effective methods of reducing test anxiety and improving academic performance of Biology students.

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OPERATIONAL DEFINITION OF TERMS/ABBREVIATIONS USED IN THIS STUDY

In the course of this study some terms have been used in special ways, and some words have been abbreviated because of their frequent use. The specially defined terms and abbreviated words are listed below:

Operationally Defined Terms

Concept maps : These are diagrammatic tools representing the relationship between related concepts.

Concepts : Categorised ideas used to explain events.

Study skill : A purposeful behaviour pattern geared towards mastering an assignment.

Cognitive strategy : A method of enhancing learning.

Cognitive style : An individual's way of perceiving and processing information.

Authoritarianism : Tendency to demand high level of respect and perfection from subordinates, and the tendency to do certain things without giving room for questioning.

Test-Anxiety : Anxiety aroused in evaluation stiaution

Anxiety levels : Low anxiety level (0 - 7); High anxiety level (8 - 21¦).

Abbreviation of Terms

F.G.G.C.	Federal Government Girls' College
S.S III	Senior Secondary Three
S.S.C.E.	Senior School Certificate Examination
J.A.M.E.	Joint Admission and Matriculation Examination
W.A.E.C.	West African Examination Council
SQ3R	Survey, Question, Read, Recite and Review
D.M.R.T	Duncan Multiple Range Test
A.A.C.L	Affective Adjective Check List

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Chapter 1

INTRODUCTION

In recent times the growth of modern science has rapidly accelerated in Nigeria from the teaching and learning of nature study in the primary schools to the teaching of primary science at the primary level, integrated science at the junior secondary school, and physics, chemistry, and biology in the senior secondary school. This is because science has come to be recognised as the 'bedrock' for technological development. Nwokolo (1993), cited in Maduemezia (1993:1) identified science and technology as "carrying the promise of great economic improvement." This is evident in the emergence of many energy saving devices used in our industries and our homes today; examples include tractors, computers, maize shellers, gari-processing machines and so on. Every aspect of life in our modern society testifies to the power of scientific understanding and explanation of our world. Every time we switch on a light, take drugs or go through complicated medical treatment, we experience science in operation.

The national aspiration for technological development and advancement places high premium on the performance of students in science at the secondary school level. Consequently, the national government under the current educational system embarked on policies aimed at pursuing vigorously this technological transformation. The educational evaluation resulted in the production of science core-curriculum. Science curriculum development experts were selected and presented with the task of evolving a modern science curriculum for Nigerian schools. The outcome of this is the emergence of three sets of science documents from the Federal Ministry of Education: core-curriculum for integrated science at the junior secondary level and core-curriculum for physics, chemistry and biology for senior secondary school (Bajah, 1988). A core-curriculum in science it was believed, will provide the necessary guidelines for science teachers all over the country.

In addition the science curriculum was structured in such a way as to progressively expose the child to science concepts. In my opinion, science education should help pupils develop

interest and awareness of their environment, while exposing them to the fundamental methods of science. And to ensure the effectiveness of science education heavy investment is made by the Federal government towards the procurement of science equipment (although this effort is (thwarted by some middlemen), setting up of science equipment manufacturing centres, and establishment of science secondary schools by some state governments, and the organisation of science workshops and seminars aimed at updating the knowledge of science teachers. Furthermore, the government's policy on admission into the federal universities which stipulate 60:40 ratio in favour of science courses lends support to this national aspiration towards technological development and advancement.

With such importance attached to science education, the indices for determining the realisation of the national goals appear to be hinged on the performance of students in science subjects at the senior school certificate examination (SSCE) and the Joint Admission and Matriculation Examination (JAME) and the fulfillment of the admission ratio. Statistical analyses from West African Examination Council (WAEC) on science entries and performance indicate that although the number of candidates offering science and science related subjects is increasing, the general performance of candidates is not impressive with less than thirty percent (30%) of the candidates in science at the credit level and above (Maduemezia, 1993). Biology a popularly offered science subject is equally hard hit. The WAEC statistical analyses of 1990, 1991, and 1992 senior secondary certificate examination result reveals that only fifteen percent (15%), twenty-five percent (25%) and twenty-eight percent (28%) respectively, passed at credit level and above, while fifty-three percent (53%), forty-five percent (45%) and forty percent (40%) respectively failed (Maduemezia, 1993).

Investigations into the possible causes of poor students' performance in science subjects such as biology revealed socio-educational problems such as parental educational and occupational status (Achebe, 1972 and Odebunmi, 1988). Nisbet and Entwistle (1966), reported a relationship between pupil's performance in secondary school and their age of transfer from primary to secondary school; this could be attributed to measure of mental readiness needed for

understanding of higher order concepts to take place. Chude (1989), on the other hand discovered that some of the factors affecting students' performance in science are logistic in nature; they are found to include inadequacy of the laboratory equipment and qualified teachers. These factors were found to affect the method of teaching adopted, the content coverage, and students' level of understanding of science concepts. Consequently, students develop anxiety responses at the approach of examination.

Sorenson (1964), described anxiety as generalised feeling of apprehension, discontent, distress, often stemming from specific frustrations and failures. The emphasis laid on paper qualification by Nigerian government, and the inadequacy of good job opportunities have made many students develop test-anxiety out of fear of failure. Test-anxiety which is the focus of this study, according to Sieber *et al.* (1977), embraces feelings of inadequacy, helplessness, heightened body reaction, anticipation of punishment, loss of status and esteem in evaluative conditions. These anxiety feelings according to Sarason (1961) and Sorenson (1968), interfere with responses relevant to the task completion, diffusing the energy which must be channeled through strong motivation if learning is to be effective. This identified negative relationship between test-anxiety and academic performance has led to the investigation into various ways of reducing test-anxiety among secondary school students. Some of these methods include systematic desensitization by Gottesfield (1979), attention-training procedure by Wine (1971), study skill training programme (Fox, 1962; Devito *et al.*, 1983 and Ihejiahi, 1991). Concept mapping strategy was also investigated on test-anxiety reduction but without a significant result (Alaiyemola, 1988). It is worthy to note that these methods except concept mapping strategy have been found to have some measure of effect on anxiety reduction. However, they have not been tested on reduction of science based test-anxiety. And since it is difficult to investigate the effectiveness of these different methods on test-anxiety reduction among biology students in a single study, the present study will focus attention on the effects of study skill training and concept mapping strategies. These two cognitive strategies have been chosen because of the demands of biology as a subject.

During the process of learning biology students are expected to build up on basic fundamental knowledge, use concepts to link up life processes. Study skill training exposes the students to systematic learning needed for the understanding of a vast subject like biology, while concept mapping strategy familiarises the students with the use of concept development in the study of biology; also it exposes them to the inter-relationship that exists between the different biology concepts and thus ensure effective learning. It is therefore hoped that the investigation of these two cognitive strategies as test-anxiety reduction tools will evolve an effective means of reducing test-anxiety among biology students.

1.1 Statement of the Problem

Several studies have revealed the negative effect of test anxiety on academic achievement in general, and science-based subjects in particular (Zuckerman, 1960; Spielberger, 1966, Tobias, 1979; and Fraser *et al.*, 1983). This is attributed to the general feeling among students that science is an abstract discipline that demands special skills for its understanding. According to Zuckerman (1960), this anxiety feeling is at its peak during testing. Such test anxiety, it is believed, elicits negative responses that interfere with constructive thinking and so leads to a lowering of performance level.

In recognition of the need to create an anxiety-free environment in our schools, investigations have been carried out on ways of reducing test anxiety among students but no effective method has been evolved for the reduction of science-based test anxiety (Alaiyemola, 1988). Science being the 'bedrock' of technological advancement, it becomes imperative that an effective means of reducing science-based test anxiety should be investigated in order to ensure effective learning of science. The problem now is how to create an anxiety-free atmosphere for an effective attempts to investigate the effects of study skill training and concept mapping strategy - subjects test anxiety, with the view of evolving an effective means of reducing it to the barest minimum for effective learning to take place.

1.2 Research Questions

In investigating an effective way of reducing test-anxiety among biology students, attempts were made at answering the following research questions.

a. Does study-skill training reduce test-anxiety level and affect the academic performance of the experimental group?

b. Does concept mapping reduce test-anxiety and affect the academic performance of the experimental group?

c. Is there any difference between the anxiety levels of subjects exposed to study skill training and those exposed to concept mapping strategy?

d. Is there any difference between the academic performance of subjects exposed to study skill training and those exposed to concept mapping strategy?

1.3 Hypotheses

For the purposes of this research the following null hypotheses were tested:

a. There is no significant difference in test-anxiety levels of the experimental and control groups after the study skill training sessions.

b. There is no significant difference in academic performance of experimental and control groups after the study skill training sessions.

c. There is no significant difference in test anxiety levels of the experimental and control groups after concept mapping strategy.

d. There is no significant difference in the academic performance of experimental and control groups after concept mapping strategy.

e. There is no significant difference between the test anxiety levels of subjects exposed to study skill training and those exposed to concept mapping strategy.

f. There is no significant difference in the academic performance of subjects exposed to study skill training and those exposed to concept mapping strategy.

1.4 Basic Assumptions

This study assumes that:

a. the test-anxiety levels of subjects will reduce after exposure to study skill training and concept mapping strategy.

b. the academic performance of subjects will improve after exposure to study skill training and concept mapping strategy.

c. the text-anxiety levels of subjects exposed to study skill training will differ from those of subjects exposed to concept mapping strategy.

d. the academic performance of subjects exposed to study skill training will differ from that of subjects exposed to concept mapping strategy.

1.5 Scope of Study

This study focuses on the effects of study skill training and concept mapping on students test-anxiety and performance in biology. The study was conducted using senior secondary III (SS III) students of Federal Government Girls' College, Zaria. This institution was chosen because being a 'Unity School', it cuts across various ethnic groups in the country. Also its being a boarding school eliminates the possibility of extra-lessons at home interfering with the experimental result, a problem often associated with experimental research using day schools. And the use of Federal Government Girls' College, Zaria, the investigator's school, enabled her monitor the subjects closely and reduced to the barest minimum possible interaction between the experimental and control groups. Furthermore, the choice of monosexual school is because the gender effect is not being investigated since the review of literature has revealed that there is no significant gender effect on student's anxiety (Alaiyemola, 1988; Ihejiahi, 1991).

Furthermore, the age factor was not investigated because the investigator used one year group (SS III) of a specified average age.

1.6 Significance of the Study

Science education has been accorded a special recognition in Nigeria. This is evident in the amount of money voted for the training of science teachers especially under the Technical Teachers Aid (T.T.I.) programme. However there is a growing concern among Nigerians on the falling standard of education in general (Ayodele, 1993), and in science education (Maduemezia, 1993). The contributory role of test-anxiety to poor academic performance calls for an identification of an effective method of reducing it, especially among biology students, biology being the quintessence of most science based professions.

It is hoped that the findings of this study will enlighten teachers, counsellors and school administrators on the implication of test-anxiety on students' academic performance, as well as help them devise means of reducing it to the barest minimum. It is also hoped that the findings of the study will assist students to learn how to learn and thus be able to exert control over their emotions.

1.7 Summary

The chapter has highlighted the position of science in the national policy, the negative relationship between test anxiety and academic performance. And emphasised the need to investigate an effective method of reducing test-anxiety among biology students with the view of improving their academic performance. The chapter also dealt with the assumptions and research questions the study hopes to answer.

Chapter 2

REVIEW OF RELATED LITERATURE

2.1 Introduction

Anxiety as a persona-educational phenomenon has attracted the attention of psychologists like Sarason (1961), Spielberger (1966) whose findings have formed the baseline for research into the effect of anxiety on academic performance. This section will review related literature under the following headings with the view of providing the theoretical background for the study.

2.2 Nature of anxiety
2.3 Causes of test-anxiety
2.4 Test anxiety and academic performance
2.5 Reduction of text-anxiety
2.6 Study skill training, test-anxiety and academic performance.
2.7 Concept mapping, test-anxiety and performance.
2.8 Summary

2.2 Nature of Anxiety

Anxiety has variously been considered as a psychological state of the human organism, as a physiological syndrome, and as a theoretical construct invoked to account for defensive behaviour and the avoidance of noxious stimuli.

As a psychological state, anxiety can not be easily demonstrated. It is not easy to point at a specific behaviour describing anxiety. However Mayer-Gross *et al.* (1969, cited in Strongman, 1980), described anxiety as adaptive response which carry unpleasant emotional overtones described as involving a strong expectation of danger, threat, and distress for which an extra effort will be needed, but about which nothing can be done at the time.

Physiologically, anxiety according to Mayer-Gross *et al.* (1969) cited in Strongman (1980), and Sarason (1961), causes a rise in the output of adrenalin, and a rise in blood pressure and heart rate. The skin becomes sweaty and pale, and the mouth dry. Also behavioural signs like excessive smoking, restlessness, tense posture, general distractibility, quivering of the limbs depict high anxiety (Ihejiahi, 1991).

As a theoretical construct psychologists have advanced many theoretical explanations for the concept of anxiety. Freud (1936), explained that anxiety is the reaction to traumatic events that are part of the individual's inherited unconscious, repressed memories. The actual emotion is explained to be a resurrection of the original traumatic emotional state triggered by some present event which stirs memory. So according to Freud (1936) anxiety is aroused as a conscious emotional experience resulting from expectation of displeasure. Anxiety in this form is self-preserving because it warns the individual of an impeding danger. The author described this form of anxiety as being objective, as opposed to neurotic anxiety which is experienced in the absence of any apparent danger. The forces of anxiety in the later situation arise from within rather than from the environment as is the case in objective anxiety. In neurotic anxiety the 'ego' is anxious and anxiety is felt as guilt, self depreciation and desire for punishment. Freud (1936), opined that anxiety can be caused by frustration of sexual desires of the 'Id' through parental ego and super-ego control and inhibition.

Slater and Shields (1969), from the findings in their study of the hereditary aspect of anxiety hypothesised that there is a high predisposition to anxiety among siblings of anxiety neurotics but contended however, that there is interaction between hereditary and environmental factors. And in line with this view, Spielberger (1966), Leherissey *et al.* (1971), King, Heinrich and Stephenson (1976) theorised that there are two forms of anxiety: State anxiety (A-State) and trait anxiety (A-Trait). A-State, the authors refer to the transitory state or condition that is characterised by feelings of tension and apprehension, and heightened autonomic nervous system activity; whereas A-Trait implies individual differences in anxiety prone, that is, the disposition to respond to elevations in A-State under conditions that are characterised by some threat to self-esteem.

Vernon (1969), on the other hand opined that anxiety is intropunitive in nature. It is like a punishing act directed inward towards self. Anxiety according to the author is typically felt in association with failure and frustration in attempt to reach a goal, and with motivational conflict.

Schwartz, and Lacey (1982), described anxiety as being subjective, unfocused and diffuse. To the authors, anxiety is an emotional state which is generally and profoundingly debilitating

and which completely suppresses effective action. Exposure to unpredictable aversive events can produce anxiety. They gave as example a child in a class where quizzes are announced to the class before being administered might be afraid during each interval between the announcement of a quiz and its occurrence, but would be relaxed on all other occasions. Whereas a child in a class where quizzes are never announced might be afraid all the time.

Sarason (1960, 1961), explained that anxiety responses are aroused by personally threatening conditions in the environment. She opined that authoritarian child-upbringing which criticises and demands perfection creates anxiety in the child. Such a child develops fear of failure to the extent that his concentration on task solving situations is impaired with; he rather engages on irrelevant self-depreciating ruminations about his capabilities. This view is supported by Bar-Tal *et al.* (1980). According to the two authors, anxiety is positively related to an external environment, and perception of lack of control over environment induces a certain amount of anxiety responses. The response according to Sarasan (1961), interfere with ongoing task relevant activity and so lead to a lowering of performance level.

In addition Bowby (1961), opined that affectional bonds between mother and child plays a role in the development of anxiety. He explained that children who experienced an unsettled early home life are far more anxious than those who had settled home lives. In line with this findings, Mischel (1971), identified stress as another cause of anxiety. A stressful condition according to him produces unpleasant feeling which increases as the stress condition increases.

Test anxiety on the other hand, according to Tobias (1973), is the form of anxiety aroused in evaluation situation especially by the variety of tests administered in most educational institutions. Morris and Liebert (1967), distinguished test-anxiety as comprising of two components, namely cognitive and emotional components. The cognitive component according to the authors, is expressed as 'worry', 'fear' and 'self-critical thinking'. This is aroused by performance expectations held by parents, difficulty of test items and failure threat; while the emotional component of test-anxiety is aroused by an environment associated by the subject with

feeling of failure, or harsh behaviour of the test conductor. Singer and Shields (1969), hold the same opinion about test-anxiety. They opined that test-anxiety is a result of previous failures and negative evaluations in schools, and that it gives rise to the expectation of subsequent failure. Smith and Morris (1976) however, discovered from their studies, that the emotional component of test-anxiety diminishes as the test progresses, whereas the cognitive component remains to the end of the examination.

The detrimental effect of test-anxiety according to Wine (1971), and Sarason (1961), results from irrelevant thoughts that interfere with the solution of the task at hand. The individual rather than address himself to solving the task before him engages in self-depreciating thoughts such as "I can't pass this test;" I wonder how the other students are doing; and so on.

2.3 Causes of Test-Anxiety

Variety of factors have been identified by psychologists as causing test-anxiety. According to Morris and Fulmer (1976), physical punishment emitted on a child for failure or poor performance in an examination could give rise to a state of stress. The child could come to associate examination with unpleasant experience that culminates in unavoidable pain. According to the authors anxiety aroused by stress factors stimulate competing task irrelevant responses which are thought to be self-evaluative in nature and which interfere with performance because they divert attention away from the task at hand. This agrees with the findings of Singer and Shields (1969), Wine (1971), and Deffenbacher (1978). They discovered from their studies on the effect of stress on high and low anxiety individuals that evaluative stress elicit behaviours that interfere with the performance of highly anxious.

In addition, fear of disgrace by either the school authority or parents could lead to development of test-anxiety in a child (Spurgeon and Gerald, 1978). The popular practice of having test-results pasted on notice boards in full view of everybody, or the calling out of poorly performed students at the school assembly for punishment could result in the development of test-

anxiety by the very sensitive and emotional students. This view agrees with the findings of Spielberge (1966) and Lehorissey *et al.* (1971), that individuals with A-Trait have the disposition to respond to elevation in A-State under conditions that are characterised by some threat to self-esteem.

Achievement motivation on the other hand has been found to underlie the anxiety shown by students during testing conditions. The urge to excel under evaluating conditions raises the stimulus drive (SD), which in turn makes the child anxious (Eysenck, 1971). This can be likened to the Nigerian situation where many students could be said to experience high test-anxiety because of the emphasis placed by the Federal and State governments on 'paper' qualification. The urge to excel in their examinations and be successful in life could lead to test-anxiety.

Inadequate preparation for an examination has also been identified as a possible cause of test-anxiety. According to Sessenrath (1967) and Devito *et al.* (1983), test-anxiety is a reality based fear arising from poor study skills and preparations for examination. This view is also shared by Fox (1962). He hypothesised that no matter how logical and clear teaching materials are, if the student does not study there is no teaching at all. Consequently, poor study habits according to the author are fundamental expressions of repeated failure, nagging anxiety combined with either failure or compensating behaviours of cheating, and meaningless memorising (cramming).

Furthermore, inadequate content coverage has been found to elicit test-anxiety in highly anxious students during examination. Tobias (1979), reported that there are three possible points where anxiety can exert a lot of effect: at the preprocessing stage, during processing, and after processing and just before output. According to Tobias (1979) anxiety at the preprocessing stage affect learning by interfering in the degree to which external stimulation has been internally represented. This can be exemplified in the student who as a result of earlier discussion with her peer group, on the complexity of a subject attends the lessons on that subject with bias on her ability to cope. Such a student according to Tobias (1979) will not have the lessons internalised

because her attention is divided between the demands of the tasks and somatic concerns. This view agrees with Morris and Fulmer (1976) and Deffenbacher (1978).

Tobias (1979) also found that difficulty of the task, reliance on memory by the students, and the organisation of the task could arouse test-anxiety during the 'processing' stage. Thus where the teaching procedure adopted by the teacher, does not allow for adequate and sequential subject organization, and content coverage, the task can be interpreted as being difficult, and could lead to the development of anxiety during examination. In addition, where the classroom environment does not reinforce the students' effort at understanding the lessons, tension builds up in the students arousing test-anxiety at the 'processing stage'. Fraser *et al.* (1983), reported that lower anxiety levels are found among students whose teachers use more positive reinforcement and directiveness, and who exhibit supportive behaviour.

Furthermore, according to Tobias (1979) anxiety can set in after the processing of instructional input, when irrelevant thoughts interfere with the solution of task at had. Alhassan (1993), for instance recognised that many students during examination rather than focus their attention on the task at hand and the subject content, are pre-occupied with thoughts of failure and having their lives ruined. These situations explain the type of interference reported by students who claim to have studied diligently yet did not perform well in the tests. This agrees with the findings of Sarason (1961) and Wine (1971), that test-anxiety results from irrelevant thoughts that interfere with the solution of the task at hand.

In addition Tobia (1979), McKeachie *et al.* (1955), and Sarason and Mandler (1952) attributed the cause of test-anxiety to the variety of tests administered in most educational institutions. In the study conducted by McKeachie *et al.* (Ibid) half of their subjects were given answer sheets on which they were asked to comment freely on; while the other half was given standæd answer sheets. The result of their findings, showed that subjects that were allowed to comment freely made higher scores than those who used standard answer sheets. The authors,

thus hypothesised that giving students an opportunity to comment on test questions reduced anxiety and its concomitant detrimental effects.

However, Muss (1960), opined that anxiety is strongly related to the individual's ability to see the relationship between cause and effect. According to the author, high casually oriented subjects show more security and less anxiety because they are aware of the dynamic and causal nature of human behaviour, and so are better able to solve their own problems and meet social situations.

2.4 Test-Anxiety and Performance

Psychologists believe that some measure of anxiety promotes academic performance, and that a high level of anxiety has a negative effect on performance. This optimum level of anxiety depends on the personality involved. According Eysenck (1971), the extroverts with low anxiety level perform better in the primary school, but at the secondary school and university level a reversal of the situation is observed, the introvert with a higher level of anxiety on neuroticism perform better academically. The author attributed this to their ability to use their strong stimuli drive (SD) constructively at the secondary and university levels, that is, in ways compatible with academic success; where as the primary school introvert child is not able to read in ways compatible with success, consequently he experiences test-anxiety. For example, a student high on neuroticism may react to strong anxiety prior to an examination by working extra hard; this would be compatible anxiety-induced behaviour leading to success. Anxiety in this circumstance acts as a secondary drive in the right direction. On the other hand, a primary school introvert pupil may develop a school or test phobia under similar conditions.

Furthermore, the effect of anxiety on performance depends on the nature of the task. According to Taylor (1956), individuals with high level of anxiety perform better on variety of simple tasks than low anxiety individuals, and the opposite was observed with more complex tasks. These findings agree with those of Stephenson and Odom (1965), O'Neill *et al.* (1969),

Tennysan and Woolley (1971), Tennysan and Boutwell (1973), and Tobias (1973), it is also consistent with Evan's (1989) view that optimal point of arousal for an easy task will lie higher on the arousal dimension for an easy task than a difficult one. Spence and Spence (1966), interpreted these findings in terms of high drive blindly energizing all responses, with incorrect responses competing with correct ones in difficult task. Thus for difficult task, high anxiety drive serves only to energize wrong responses bringing them nearer to threshold. Anxiety, therefore is a disruptive influence when preparation has been less adequate.

Deffenbacher (1978) investigated the effect of stress and anxiety on academic performance. He worked with three groups of subject: high anxiety high stress evaluation group, high anxiety low stress evaluation group, and low anxiety high stress evaluation group. He found from the study that high anxiety high evaluation stress group reacted more negatively to testing, they experienced greater interference from anxiety and they reported greater attention to worrisome thoughts, heightened physiological arousal and task generated interference, than did either the high anxiety low stress evaluation group or low anxiety high stress evaluation group. This findings agree with those of Mischel (1971), Morris and Fulmer (1976), that evaluation stress elicits behaviour which interfere with the performance of the highly anxious; and also confirms Spielberger (1966) Trait-State Anxiety theory which states that students who are high in A-trait perceive the stress associated with the midterm and final examination as more threatening than students low in A-trait and, therefore respond to the examination situations with greater elevations in A-state.

In addition rigidity was identified by Sorenson (1968) as an important part of anxiety. Anxious students according to him lack the flexibility and facility needed not only in imaginative and creative thinking but also in reasoning, as is demonstrated by research findings that anxious students sometimes do better than non-anxious students in simple mechanical performance, but regularly do less well in complex problem solving (Taylor, 1956).

The anxious learner therefore is in the situation of striving to dispel painful tension, the result of his ragging fear, and at the same time having his efforts frustrated by the very tension which he seeks to dispel. The symptoms of rigidity and diffuse efforts reflect this contradiction; they stem from the fact that the learner is being asked to dispel tension by means that are continually weakened by his own anxiety and uncertainty. This high anxious persons are neither cautions nor accurate problem solvers when necessary information is not available and organised for them in some external form. This is because in such situations they seek less information before making decisions, and reach decisions more rapidly. Their word-association performances according to Stephenson and Odom (1956) are more characterised by errors of commission consisting of emitting first-available, incorrect responses. Fraiser *et al.* (1983) explained that the low academic performance of high anxious person is as a result of high anxiety state eliciting sympathetic overactivity of the brain with the resultant depression in learning.

Consequently, optimum performance in biology, a science subject of high cognitive order and evaluation stress can only be achieved with low anxiety. It is therefore, necessary to devise means of lowering the test-anxiety level of biology students in order to have effective learning and improved academic performance. It is with this view in mind that the researcher decided to investigate the effects of the cognitive strategies, study skill training and concept mapping strategy, on students anxiety and performance in biology.

2.5 Reduction of Test-Anxiety

Based on the general consensus that test-anxiety correlates negatively with academic performance many psychologists have been motivated to find ways of reducing test-anxiety to the barest minimum so that the test-anxious individuals can improve on their performance. But it is worthy to note that test-anxiety is not the only factor debilitating against high academic performance. Factors like home background, level of intelligence, teaching method, content coverage, grading, poor study skill and lack of interest could also result to poor academic

performance, although these factors are also indirectly associated with the development of test-anxiety. Test-anxiety therefore, appears to be the immediate cause of poor academic performance, hence the need to find an adequate means of reducing it.

One of the test-anxiety reduction therapies is systematic desensitization. This therapy focuses on reducing the emotionality of test-anxiety. It employs the principle of imagining and visualizing anxiety hierarchy (Gottesfield, 1979). It begins with establishment of relaxation, a physiological state that is incompatible with anxiety. The subject is taught how to relax groups of muscles until the body is relaxed. The therapist then introduces an anxiety hierarchy, a group of stimuli ranging from those that cause little anxiety to those that evoke considerable anxiety. As the stimuli that produce least anxiety are introduced, the patient is instructed to relax. Gradually stimuli that produce more anxiety are introduced accompanied by instruction to relax. Hypnosis and drugs are at time used in conjunction (Gottesfield, 1979). A successful therapy according to the author, will have the subject approach the previously feared situation with little or no anxiety. However, the occasional use of drugs and hypnosis in systematic desensitization does not make it the classroom choice. Also Ganzalez (1976) found from his studies on systematic desensitization that desensitization of high anxious subjects with good study habits had a positive effect on academic performance but had no effect on the academic performance of subjects with poor study skills. Katahn *et al.* (1966), on the order hand found from his student that systematic desensitization on its own may not necessarily improve academic performance. He tried a combination of desensitization and counselling and found the strategy effective in reducing anxiety and promoting academic performance.

Implosive therapy (flooding) is also employed in the treatment of anxiety. According to Gothesfield (1979), the technique is based on the tenet of behaviourist therapy which says that when a situation continuously stimulates anxiety, if the anxiety is not reinforced, the response to the anxiety will be extinguished. The subject is thus requested to imagine being in a situation of the greatest threat and anxiety. Unlike systematic desensitization, implosive therapy does not

require the patient to relax, instead he is forced to stay with imagined situation for a prolonged time. The rationale is that, in time, the threatening stimulus will lose its ability to arouse the anxiety of the subject. However the use of implosive therapy in the reduction of test elicited anxiety has not been investigated.

Wine (1971), on the other hand devised attention training procedure to modify the withdrawal of attention from task at hand as a result of task irrelevant thoughts entertained during testing by many test anxious students. In this approach, subjects are exposed to intensive practice on a variety of test like tasks with instructions and training to inhibit self-relevant thinking and focus attention on tasks at hand. This technique was found by Wine (ibid.) to promote academic performance because the subjects were then able to address themselves to the task solving situation.

Meichenbaum (1972, cited in Ihejiahi, 1991), in his attention training procedure devised a systematic way of modifying some of the cognitive variable thoughts entertained by test-anxious subjects during testing. He used an 'insight' therapy procedure to identify the specific self-oriented task-irrelevant worried thoughts emitted by subjects during testing situations. They are then taught to generate alternative 'self instruction or self-talk' which do not divert attention away from the task at hand.

Sieber *et al.* (1970), investigated the reduction of test anxiety through memory support. According to the authors anxiety interferes with memory but from their studies they discovered that when memory support is provided, anxious persons appear to take advantage of it and thereby improve on their level of performance. They therefore, concluded that anxiety interferes with short-term memory, but that the performance of high anxious students can be improved when the task is structured to provide external aids, there is thus less dependency on memory. This finding is in agreement with the findings of Paulsan (1969), and Leherissey *et al.* (1971). The interpretation of the superior performance of high A-state students in the memory support (MS) versus the non-memory support (NMS) condition may be derived from drive theory of

Spence and Spence (1966). This theory predicts that the effects of drive (State anxiety) on learning depend on the relative strength of correct and competing error tendencies. So if as Sieber *et al.* (1970), and Paulson (1969), claim that memory support reduces the disruptive effects of anxiety on memory, memory support may be seen as reducing the competing response tendencies, that is, the task irrelevant responses, for high anxious students which would reduce their errors.

Expectation and attributions have been found to play a role in the alleviation of learned helplessness. Dweck (1975 cited in Smart and Smart, 1977) found that the use of explicit unambiguous feedback was helpful to test anxious children. He therefore suggested that adults should provide an explanation for the child's failure as well as, strategies for enhancing successful performance.

2.6 Study Skill Training, Test-Anxiety and Academic Performance

Akinboye (1984, cited in Ihejiahi, 1991), described study skill training programmes as a determined purposely behaviour pattern geared towards previewing, questioning, reading, reciting and reviewing in an attempt to master an assignment. It is therefore aimed at promoting effective learning. According to Fox (1962), no matter how logical and clear teaching materials are, if the students do not study there is no teaching at all. The issue of efficient education therefore, pivots on study behaviour of the students. The consequences of poor study habits are fundamental expressions of repeated failure, nagging anxiety combined with either failure or compensating behaviour of cheating, and meaningless memorization (Fox, 1962).

Devito *et al.* (1983) reported that test-anxiety is a natural reaction from poor study and test-taking skills; study skill training programme is thus aimed at helping subjects develop good study and test-taking skills. If effective learning takes place it is believed that test-anxiety will be minimal. Bruce (1972) opined that high test anxious students' poor performance is partially due to ineffective, inappropriate pre-examination behaviour. This view is supported by Ihejiahi (1991). The result of the latter's eight weeks therapy on high test anxious students revealed that

study skill training session can be used as a therapy for test-anxiety reduction and improvement of academic grades. These findings agree with those of Spielberger (1966), and Devito *et al.* (1983) that test anxiety is reality based fear resulting from inadequate study skills and preparations for tests.

Study skill programme thus assists subjects to re-examine and restructure their study pattern to a more productive pattern that will meet their academic demands.

2.7 Concept Mapping, Test-Anxiety and Academic Performance

Concept according to Dienes (1959) is a construction of a configuration out of perceptually categorised events. A formed concept is internalised or consolidated by applying it to external concrete situation so that experience of its function can be acquired; or by linking it up with other formed concepts in the interpretation of external concrete situation. Such vertical associations form the basis of concept mapping, and according to Wickelgren (1979), they endow the mind with the capacity to define new nodes or concepts to represent combinations of previously defined nodes. Such a memory according to the author that has a growing, rather than a static representational capacity can thus be described as meaningful learning. This appears to agree with Ausbel's theory of meaningful learning which asserts that meaningful learning occurs when new knowledge is consciously linked by the learner to existing concepts the learner already knows.

Novak *et al.* (1983), developed concept mapping to illustrate progressive differentiation of new proposition. He explained that students through the concept mapping strategy can for instance, relate the concept of space to the structure of solids, liquids and gases and recognise that it is the amount of space between molecules that account for the expansion of substances and not a "fattening" of the component molecules. Concept mapping it thus, appears, promotes integrative reconciliation of ideas and propositions.

Concept mapping as an educational tool can be constructed by having the most general concept at the top with the less inclusive concepts below it in a hierarchical order (Novak *et al.*,

1983). Cliburn Jnr. (1987) contends that concept maps are useful as advance organiser, as pre-instructional strategy which presents the relevant background concept for a subsequent unit of study and can also be used by the students at the processing and post-processing stages for integration and consolidation of facts. And investigation was revealed that concept strategy enhances meaningful learning (Novak *et al.*; 1983; Novak and Gowin, 1984; Cliburn Jnr. 1987; and Alaiyemola, 1988).

According to Novak *et al.* (1983) concept maps because they represent hierarchies and propositional relationships between related concepts, serve as a tool to assist students understand concepts, see and appreciate relationship between concepts. Alaiyemola (1988) advocated for student concept mapping approach. This according to the author is more process-oriented and allows the subjects to discover the meaning and relationship in the concepts. This view is supported by Cliburn Jnr. (1987). He contended that process-oriented concept mapping is an ideal way to stress conceptual organisation and integration, and that its visual nature is inherently superior to verbal ways of organising information and so leave more lasting impression on the minds of the subjects. The advantage of concept mapping therefore abounds in its emphasis on integrating concepts and anchoring them to concepts in events and objectives, thus, promoting integrative reconciliation. This quality places concept mapping strategy above rote learning which burdens the students with the stress of meaningless memorisation and frustrating emphasis on reproducing information exactly as presented.

However, the effect of concept mapping strategy on test anxiety reduction has not been established, but the investigator feels that such a cognitive strategy that promotes integrative reconciliation and enhances performance will positively affect test-anxiety. From the review of related literature on anxiety, it is hypothesised that for a test anxiety reduction therapy to lead to improved academic performance focus of the therapy should go beyond elimination of emotional arousal during examination and that some study counselling need to be employed in the therapy (Spielberger *et al.*, 1978). It is also contended that high anxious persons may benefit from learning through the use of various external aids such as diagrams, notational systems, which if consolidated could act as internal memory aids that permit efficient information processing (Sieber *et al.*, 1970). And since learning according to Wickledgren (1979), takes place when

associations between nodes are strengthened; it is hoped that investigation of study skill training and concept mapping strategy will evolve a suitable way of reducing test-anxiety among science students.

2.8 Summary

The review of related literature has shown that anxiety can have effect on academic performance and that study skill training and concept mapping strategy can promote effective learning. It has therefore became necessary to examine the effect of these two cognitive strategies on students' anxiety and performance in biology.

Chapter 3

METHODOLOGY

3.1 Introduction

This research study investigated the effects of study skill training and concept mapping strategy on students' test anxiety and performance in Biology. The investigation involved the following steps:

(a) Sample selection procedure (from population)
(b) Design of instrument
(c) Selection of the research design
(d) Selection of statistical methods for the analyses of the data

3.2 Population

The parent population for this research consisted of four hundred and nine (409) Biology students of F.G.G.C., Zaria; however, the target population from which the sample was drawn was the one hundred and thirty-nine SS III Biology students of the college during the 1994/95 session. This year group was chosen for the research because they have been exposed to most of the basic concepts in Biology which would enable them appreciate the demands of the subject and be able to link up related concepts. The possibility of their forthcoming SSCE eliciting test anxiety in themâas also taken into consideration.

3.3 The Sample and Sample Selection Procedure

The sample was obtained from the rating of the subjects' scores in test-anxiety and achievement pre-tests. And for the purpose of this research, the subjects that scored between 8 and 21 on the anxiety scale, and less than 40% in Biology achievement test, constituted the working sample. Eight (8) was chosen as the lower limit on the anxiety scale based on Zuckerman (1960) findings, that at this level test anxiety starts eliciting negative effect on

academic performance during testing period. And 40% was chosen as the pass mark for Biology achievement in accordance with the standard of the school used for the study.

The experimental and control groups were determined through random sampling. Letters 'E' and 'C' were written on folded pieces of papers, and the subjects made to pick one each. Those that picked letter 'E' constituted the experimental group, while those that picked letter 'C' formed the control group.

3.4 Instrumentation

3.4.1 Test-anxiety

A version of Zukerman's (1960) AACL was used as the research instrument. This is a self-report instrument consisting of 21 key words embedded in the total list of 60 adjectives arranged alphabetically. The subjects were instructed to underline as many, or as few of the words that describe how they feel about Biology. The 11 words designated with (+) were scored 1, if they were underlined, and scored 0, if they were not underlined; while the 10 words designated (-) were scored 0 if they were underlined and 1, if not underlined. The remaining 39 words were ignored in the score procedure. Each subject's total anxiety score was obtained by summing up the scores obtained for the 21 key words. The possible range of scores is 0 to 21.

The Affective-Adjective Check-list has been chosen as the test-anxiety instrument because it provides a quick measure of test-anxiety level, especially for a study of this kind where repeated assessments of anxiety must be made within a relatively limited time interval. It also measures the presence and intensity of responses which facilitate performance (AACL-), and those which debilitate it (AACL+) (Appendix I).

3.4.2 Validity and reliability of test-anxiety instrument

The validity of the test-anxiety scale has been determined by Jegede and Okebukola (1987). It was found to have a correlation of between 0.62 to 0.74 with other measures of anxiety; and high reliability test-retest of 0.83.

3.4.3 Achievement

Biology achievement was measured with a fifty item multiple choice objective instrument from past WAEC question papers. Each item has 5 possible answers from which the subjects chose only 1 correct option (Appendix 2&3). Each correct answer scored 2 marks, thus giving the maximum obtainable mark to be 100.

3.4.4 Validity and reliability of achievement instrument

WAEC questions are standardised and validated; however to ensure that the items chosen were of the same difficulty level, since they were picked from different past question papers on the topics taught during the research, item analysis was carried out.

3.5 The Research Design

The pre-test, post test, control group, experimental design was used for the study. This design according to Specter (1987), involves measurement of two dependable variables, anxiety and academic achievement. Using this design, comparisms were made before and after treatment of experimental groups. It was therefore assumed that the differences between pre-test and post test results were due to the effects of the treatments that occurred in between.

The identified high test anxious and poor Biology achievers were randomly assigned to experimental and control groups. The experimental group was further divided into 3 sub-groups - E1, E2 and E3. These were written on folded pieces of papers and subjects were made to pick one each. All the groups were taught with expository method. In addition, the first sub-group (E1) was given 6 weeks treatment on study skill training; the second sub-group (E2) was given 6 weeks treatment on concept mapping strategy;l while the third sub-group (E3) was given 6 weeks treatment on concept mapping and study skill training. The control group (c) was taught with just expository method. Each group was exposed to 2 periods of 70 minutes per week.

3.5.1 Study skill training strategy

Study skill training technique is based on the notion that most high test anxious subjects have poor study technique; it therefore, aims at teaching subjects effective study strategy. The technique has been found by Spielberger (1966), Bruce (1972), and Ihejiahi (1991) to be useful in test-anxiety reduction and improvement of academic performance. To investigate its effectiveness in the reduction of science based test-anxiety, the following programme was followed:

The 2 sessions of the first week was used thus:

(a) to get familiarised with the study problems of the subjects;

(b) subjects were made to appreciate the importance of good study habit to academic performance;

(c) subjects were helped to construct, or modify their study time table, in order to ensure higher productivity.

During the next 2 sessions of the second week, the subjects were taught how to reinforce their effort. This is based on the generally accepted notion that low probability behaviour like studying if made to precede a high probability behaviour like playing with friends, could be encouraged. The subjects' hobbies were used as reinforcers. Also during these 2 sessions of the second week, subjects were made aware of the need to:

(a) be attentive in the class;

(b) review notes immediately after the lessons;

(c) tackle assignments as soon as they are given instead of procrastinating;

(d) tackle the difficult aspects of their study assignments when they are most fresh, like in the morning, or after a good rest in the evening;

(e) take only one assignment per time to study place;

(f) schedule time for completion of assignment;

(g) study continuously instead of leaving work until examination is at hand.

The next 6 sessions of the third, fourth, and fifth weeks of the training programme were used to assist the subjects practice survey, question, read, recite and review (SQ3RS) study technique.

***Survey*:** The subjects were made to go through a couple of assignments given to them. This was aimed at helping them get a general impression of what the assignments were all about.

***Question*:** While surveying the assignments, they were taught to raise questions in their mind. These questions were aimed at helping them magnify the critical parts of the study assignments and thus guide their reading to avoid distraction.

***Read*:** As a follow-up to survey, and question techniques, subjects were advised to read intensively and repeatedly, and to note main ideas and details in their readings that are related to the questions they have raised on the topics.

***Recite*:** Next, the subjects were taught to recall studied ideas by jotting down critical points read, or discussing with their mates. This technique helps students know how much of the topic studied has been understood; it also reinforces learning.

***Review*:** Subjects were taught to use review technique to look up facts they could not recall or recite.

The last 2 sessions of the sixth week were used to teach the subjects how to prepare for and write examination:

(a) Revision should start early enough in the term.

(b) Keep to the revision plan.

(c) Avoid studying new topics very close to examination time.

(d) Arrive early to the examination hall, and try to remain calm and confident all through the examination.

(e) Read instructions carefully.

(f) Write an organised outline to each question to guide their answers.

(g) Allocate time to every question in order to ensure that all questions are attempted (per instruction).

(h) Do their best questions first as this will help them build up confidence in themselves.

(i) Make out time to read over answer scripts, correct errors, and assemble their papers correctly, ensuring that their names and examination numbers are clearly written on all used sheets before submission.

3.5.2 Concept mapping strategy

The treatment consists of teaching concepts using the concept mapping strategy. The concepts taught were the ones on the subjects' scheme of work at the time of the study. They were taught how to construct concept maps by having the most general concepts at the top with the less inclusive concepts below it in a hierarchical order. The adherence to the subjects' scheme of work prevented the exercise from being seen as a waste of time. The concepts taught during the period were:

(a) Nutrition

(b) Respiration

(c) Excretion

(d) Population study.

(See appendices 4, 5 and 6 for samples of concept maps used).

At the end of the 6 weeks treatments, the 3 sub-experimental groups and the control group were given post tests on test-anxiety and academic achievement.

3.6 Statistical Method

Correlation analysis was used to establish the relationship between test-anxiety and academic performance. Pearson Momment Correlation statistics was chosen based on the assumption that the two variables, anxiety and academic achievement are both random variables which may be dependent or independent of each other; and the interest of this research is to determine the degree of the association.

The t-test statistics was used to test the null hypothesis of no significant difference between the effects of t strategies used - study skill training and concept mapping. The t-test was considered an appropriate statistical tool because the research design involved the use of 2 means from 2 sample sets.

Thereafter, analysis of variance and Duncan Multiple Range tests were used to determine the treatment(s) that is most significantly different from the rest with the view of finding out the best treatment that would reduce test-anxiety and improve academic performance.

3.7 Summary

This chapter highlighted the methodology that was used for the study, and the statistical methods that were employed for the analyses of the data.

Chapter 4

RESULTS AND STATISTICAL ANALYSES

4.1 Introduction

The results obtained from the research and the statistical analyses conducted are presented in this chapter.

Correlation analysis of achievement on test-anxiety was carried out to establish the relationship between academic performance and test-anxiety. Thereafter, t-test statistics was used to analyse the data to determine the difference between the test-anxiety levels and academic performance of experimental groups and the control group; while the analysis of variance and Duncan Multiple Range test were used to determine the difference between the treatments, and the strategy that is the most effective in reducing test-anxiety and improving academic performance. The data used for the analyses are shown in Appendix 7.

4.2 Comparism of Pre-Achievement Scores, and Pre-Anxiety Levels of the 3 Sub-Experimental Groups and the Control

As a prelude to the study, the pre-achievement scores and anxiety levels of the 3 sub-experimental groups were compared with those of the control group in order to determine if the subjects were of the same academic and anxiety levels. The t-test analyses carried out revealed that there is no significant difference in their academic and test-anxiety levels. The tables of analyses are shown in Appendix 8. It was therefore assumed that differences recorded after the treatments were administered were as a result of the treatments given.

4.3 Relationship between Test-Anxiety and Academic Performance

The post anxiety scores (X) and academic performance scores (Y) were used for a correlation analysis in order to determine the relationship between anxiety and academic performance. The correlation coefficient was found to be -0.83, and the r^2 value found to be 68.33%. This shows that academic performance is significantly negatively correlated with test-anxiety; as one is increasing the other is decreasing (Appendices 9&10).

4.4 Differences in Test-Anxiety Levels of Study Skill

The pre- and post test anxiety levels of the experimental group for study skill training were compared to determine the effect of the strategy on the anxiety level of subjects using 2-tail students t-test. Thereafter, the post test-anxiety levels of the experimental sub-group (E1) was compared with those of the control (c) to test the null hypothesis of no significant difference.

Table 4.1: t-test of pre- and post anxiety levels of study skill experimental sub-group (E1).

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Pre-test level (E1)	12	13.67	2.74					
				4.42	2.84	0.58	3.815	22
Post test level (E1)	12	9.25	2.93					

$\alpha = 0.05$

The difference in means of pre-test and post test-anxiety levels of study skill sub-experimental group gave a t-value of 3.82. Since 3.82 > 1.72 the t-critical, it could be said that study skill training reduced the subjects' test-anxiety level.

Table 4.2: t-test for post test-anxiety levels of study skill sub- experimental (E1) and control (c) groups.

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Experimental group (E1)	12	9.25	2.93					
				3	2.63	0.53	2.79	22
Control group (c)	12	12.25	2.30					

$\alpha = 0.05$

The comparism of the anxiety levels of study skill experimental sub-group (E1) and control group gave a t-value of 2.69; since 2.70 > 1.72, the null hypothesis of no significant difference is rejected at 0.05 level of significance. This collaborates the finding in Table 4.1. Thus, study skill training reduces the test-anxiety level of subjects.

4.5 Differences in Academic Performance of Study Skill Training Group (E1)

The effect of study skill training on subjects' academic performance was determined by comparing their pre- and post test scores. Then the post scores of the sub-experimental and control groups were compared. The hypothesis tested is HO: There is no significant difference in the academic performance of experimental and control groups of study skill training strategy.

Table 4.3: t-test for pre- and post academic performance of study skill sub-experimental group (E1).

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Pre-test (E1)	12	35.33	2.84					
				17.84	6.11	1.25	-7.15	22
Post-test (E1)	12	53.17	8.16					

$\propto = 0.05$

The differences in means between the pre- and post-test scores gave a t-value of -7.15 which is greater than 1.72 (t-critical). Study skill training could then be said to have improved the academic performance of the subjects.

Table 4.4: t-test of post academic performance scores of study skill experimental sub-group (E1) and control group (c).

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Experimental group (E1)	12	53.17	8.16					
				10.92	7.89	1.61	3.39	22
Control group (c)	12	42.25	7.62					

$\propto = 0.05$

The above Table shows that the difference in means of post scores of the experimental and control groups gave a t-value of 3.39. Since 3.39 > 1.72, the null hypothesis of no significant difference is rejected at 0.05 level of significance. This collaborates the finding in Table 4.3.

4.6 Differences in Test-Anxiety Levels of Concept Mapping Strategy Group

The pre- and post-test anxiety levels of concept mapping sub-experimental group (E2) were compared to determine the effect of the strategy on the anxiety levels of the subjects. Thereafter, the post anxiety levels of the sub-experimental group were compared with those of the control group (c) to test the hypothesis (HO): There is no significant difference in the test anxiety level of the experimental sub-group and control group of concept mapping strategy.

Table 4.5: t-test for pre- and post-test-anxiety levels concept mapping experimental sub-group (E2).

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Pre-test (E2)	12	14.5	2.78					
				5.42	2.71	0.55	4.89	22
Post-test (E2)	12	9.08	2.64					

$\propto = 0.05$

The comparism of the pre- and post-test anxiety levels of the concept mapping experimental sub-group indicate reduction in test-anxiety levels after the treatment was administered. The Table shows that t-calculated, 4.89 > t-critical of 1.72.

Table 4.6: t-test of post anxiety levels of concept mapping experimental sub-group and control groups.

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Experimental sub-group (E2)	12	9.08	2.64					
				3.17	2.48	0.51	-3.13	22
Control group (c)	12	12.25	2.30					

$\propto = 0.05$

The difference in means of test-anxiety levels of concept mapping experimental sub-group and control group gave a t-value of -3.13. And since -3.13 > 1.72, the null hypotheses of no significance difference is rejected at 0.05 level of significance.

4.7 Differences in Academic Performance of Concept Mapping Strategy Group

The effect of concept mapping strategy on academic performance of the subjects was determined by comparing the pre- and post test achievement scores of the experimental sub-group, as well as the post test scores of the sub-experimental and control groups. The hypothesis tested is HO: There is no significant difference in the academic performance of experimental and control groups of concept mapping strategy.

Table 4.7:t-test for pre- and post academic performance test scores of concept mapping experimental sub-group (E2).

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Pre-test (E2)	12	35	2.49					
				27.33	3.27	0.67	-20.5	22
Post test (E2)	12	62.33	3.89					

$\propto = 0.05$

Table 4.7 shows that concept mapping strategy improved the academic performance of the subjects, since t-calculated, -20.5 > t-critical, -1.72.

Table 4.8: t-test for post academic performance scores for concept mapping experimental sub-group (E2) and the control (c).

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Experimental sub-group (E2)	12	62.33	3.89					
				20.08	6.05	1.23	8.13	22
Control (c)	12	42.25	7.62					

$\propto = 0.05$

Table 4.8 shows that the difference in means of the post test scores of academic performance of experimental and control groups has a t-value of 8.13. Since 8.13 > 1.72, the null hypothesis of no significant difference is rejected at 0.05 level of significance. Thus concept mapping strategy promotes academic performance.

4.8 Differences in Anxiety Levels of Study Skill Experimental Sub-Group and Concept Mapping Experimental Sub-group

The post anxiety levels of study skill training and concept mapping experimental sub-groups (E1 and E2) were compared. The hypothesis tested is, Ho: There is no significant difference between the test-anxiety levels of subjects exposed to study skill training sessions and those exposed to concept mapping strategy.

Table 4.9: t-test for post test-anxiety levels of study skill experimental sub-group and concept mapping experimental sub-group.

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Study skill group (E1)	12	9.25	2.93					
				0.17	2.79	0.56	0.15	22
Concept mapping group (E2)	12	9.08	2.64					

$\propto = 0.05$

Table 4.9 reveals that the difference in means for the post test-anxiety levels for study skill experimental sub-group and concept mapping experimental sub-group, has a t-value of 0.15. Since $0.15 < 1.72$, the null hypothesis of no significant difference is retained at 0.05 level of significance. Thus, there is no significant difference between the effects of study skill training and concept mapping strategy on subjects' test-anxiety levels.

4.9 Differences in the Academic Performance of Study Skill Training, and Concept Mapping Experimental Groups

This section of the analysis is aimed at determining the difference in academic performance of subjects exposed to study skill training sessions and those exposed to concept mapping strategy. The hypothesis being tested is (Ho): There is no significant difference in the academic performance of subjects exposed to study skill training sessions and those exposed to concept mapping strategy.

Table 4.10: t-test for post academic performance scores of study skill training and concept mapping experimental sub-groups.

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Study skill group (E1)	12	53.17	8.16					
				9.16	6.39	1.30	-3.51	22
Concept mapping group (E2)	12	62.33	3.89					

$\propto = 0.05$

Table 4.10 reveals that there is significant difference in the academic performance of subjects exposed to study skill training sessions and those exposed to concept mapping strategy, since the t-value for their mean differences, -3.51 >-1.72. The null hypothesis of no significant difference is therefore rejected at 0.05 level of significance.

4.10 The Combined Effect of Study Skill Training and Concept Mapping Strategy on Test-Anxiety of the Subjects

This section of the analysis is concerned with determining the combined effect of study skill training with concept mapping on the test-anxiety levels of the subjects. The combined effect is compared with the effects of the single strategies.

Table 4.11: t-test for the post test-anxiety levels of the combined strategy experimental sub- group (E3) and study skill experimental sub-group (E1).

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Combined strategy (E3)	12	6.58	1.62					
				2.67	2.37	0.48	2.76	22
Study skill (E1)	12	9.25	2.93					

$\propto = 0.05$

The difference in means for the two treatments gave a t-value of 2.76; since 2.76 > 1.72 it follows that the combined strategy effect on subjects' test-anxiety levels is significantly different from that of subjects exposed to study skill training sessions only.

Table 4.12: t-test of the post test-anxiety levels of experimental sub-groups of the combined strategy and concept mapping.

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Combined strategy (E3)	12	6.58	1.62					
				2.5	2.19	0.45	2.79	22
Concept mapping (E2)	12	9.08	2.64					

$\propto = 0.05$

The analysis in Table 4.12 shows that the t-value for the mean differences of the two strategies is 2.79. Since 2.79 > 1.72, it follows that there is significant difference in the effects of the two strategies on the subjects' test-anxiety levels.

4.11 The Combined Effect of Study Skill Training with Concept Mapping on the Academic Performance of the Subjects

This section is aimed at determining the difference between effects of the combined strategy and the single treatments on the academic performance of the subjects.

Table 4.13: t-test of the post academic performance scores of the combined strategy (E3) and study skill training experimental sub-groups.

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Combined strategy (E3)	12	69.25	8.16					
				16.08	8.32	1.73	-4.73	22
Study skill (E1)	12	53.17	8.49					

$\propto = 0.05$

The difference in means of the two strategies gave a t-value of -4.73; since -4.73 > -1.72, there is significant difference in the effects of the two strategies on academic performance of the subjects.

Table 4.14: t-test of the post academic performance scores of the combined strategy, and concept mapping experimental sub-groups.

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Combined strategy (E3)	12	69.25	8.49					
				6.92	6.60	1.35	-2.57	22
Concept mapping (E2)	12	62.33	3.90					

$\propto = 0.05$

The analysis in Table 4.14 shows that there is significant difference in the academic performance of the subjects exposed to the combined strategy, and those exposed to only concept mapping strategy, since the t-calculated of -2.57 > t-critical of -1.72.

4.12 Analysis of the Pre- and Post-Anxiety Levels,, and Academic Performance Scores of the Control Group

t-test analyses were carried out on the pre- and post-anxiety levels, as well as the academic performance scores of the control group in order to determine the effectiveness of the tool and the reliability of the results obtained.

Table 4.15: t-test for the pre- and post-test-anxiety levels of the control group.

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Pre-test (c)	12	13.67	2.64					
				1.42	2.48	0.51	1.407	22
Post test (c)	12	12.25	2.30					

$\propto = 0.05$

Table 4.15 shows that at 0.05 level of significance there is no significant difference in the pre- and post anxiety scores of the control group since the t-calculated of 1.40 < to-critical of 1.72.

Table 4.16: t-test for pre- and post academic performance scores of the control group.

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Pre-test (c)	12	35.08	3.55					
				7.17	5.94	1.21	-2.95	22
Post test (c)	12	42.25	7.62					

$\propto = 0.05$

The above Table reveals a significant difference in the pre- and post academic performance scores of the control group. This could be attributed to human element factor and the nature of the topics taught during the research period.

4.13 Comparison of the Effects of the Three Strategies on the Subjects' Test-Anxiety and Academic Performance

This analysis was carried out to determine the degree of the differences between the effects of the three strategies used, study skill training, concept mapping, combination of study skill training with concept mapping, and control - on the subjects' test anxiety and academic performance; and the most effective strategy. The pulled scores for the test-anxiety and academic performance were used for the analysis.

Table 4.17: Analysis of variance of the post-test scores of the three strategies and the control for test-anxiety and academic performance.

Sources of variation	Sum of squares	d.f.	Mean	F-ratio	Sign. 0.01	Level 0.05
Main effects	5568.750	4	13920.438	473.180		
Group effects	1626.708	3	542.236	18.441	3.95	2.68
Test effects	54055.042	1	54055.042	1000.0		
2-Factor Interactions						
(Group effect x Test effect)	3493.0417	3	1164.3472	39.604		
Residual	2587.1667	88	29.399621			

Table 4.17 above shows that the mean square value for the group effects gave an 'F' ratio of 18.441. Since 18.441 >3.95 > 2.68, it follows that the effects of the three strategies and control on the subjects' test anxiety levels, and academic performance scores are highly significantly different at 0.01 and 0.05 levels of significance.

To determine which of the strategies is most significantly different, thus most effective in reducing test-anxiety and promoting academic performance, Duncan Multiple Range test was carried out.

Table 4.18: The degree of difference between the three strategies and the control using D.M.R.T.

Variables	Means	Ranking		
Control	27.25	x		a
Study skill training strategy (E1)	31.21		x	b
Concept mapping strategy (E2)	32.71		x	c
Combined strategy of study skill training with concept mapping strategy (E3)	37.92		x	c

Standard Error ± 1.11.

x Only means followed by different alphabets differ significantly, according to D.M.R.T.

From the above Table 4.18 it follows that the control had the least effect on the subjects' test-anxiety and academic performance, followed by study skill training; while concept mapping strategy, and the combined strategy of study skill with concept mapping, do not differ significantly. Although the means of the variables show that the combined strategy had the best effect on the subjects' test anxiety and academic performance, it can be used interchangeably with concept mapping strategy since DMRT has shown that there is no significant difference between their effects.

4.14 Summary

The results and statistical analyses used to test the four hypotheses were presented in this chapter. The results obtained incidate that:

(a) Academic performance is significantly negatively correlated with test anxiety.

(b) The test anxiety levels of experimental groups reduced after exposure to study skill training sessions and concept mapping strategy.

(c) The academic performance of experimental groups improved after study skill training sessions, and concept mapping strategy.

(d) There was no significant difference between the test anxiety levels of subjects exposed to study skill training and those exposed to concept mapping strategy.

(e) There was significant difference in the academic performance of subjects exposed to study skill training and those exposed to concept mapping.

(f) There was significant difference in the test anxiety levels of subjects exposed to the combined strategy of study skill training with concept mapping, and those exposed to either study skill training or concept mapping alone.

(g) There was significant difference in the academic performance of subjects exposed to the combined strategy of study skill training with concept mapping, and those exposed to either study skill training or concept mapping alone.

(h) The combined strategy therapy, and concept mapping had the best effect on subjects' test anxiety and academic performance.

Chapter 5

DISCUSSION, SUMMARY AND RECOMMENDATIONS

5.1 Introduction

This chapter contains the discussion of the results obtained from the research. The summary of the procedure used, the findings of the research, as well as, the recommendations made are also contained in the chapter.

5.2 Discussion

It has been hypothesised that test-anxiety is negatively correlated with academic performance (Taylor, 1956, Stephenson and Odom, 1956, Mischel, 1971, Morris and Fulmer, 1976, and Fraiser *et al.*, 1983). This study which sought first to establish this relationship agrees with this finding. The correlation analysis gave an r value of -0.83 (Appendix 8). And the graph of achievement against test anxiety revealed a linear relationship (Appendix 9). This indicates that as one factor is increasing the other is decreasing and vis versa. The investigation revealed that high test anxious subjects performed poorly in questions of high mental order, such as application and analysis questions. This finding agrees with those of Taylor (1956), Stephenson and Odom (1965), O'Neill *et al.* (1969), Tennyson and Woolley (1971), and Tobias (1973). This could be as a result of high level of test anxiety eliciting high stimuli drive which blindly energized all responses with incorrect ones competing with the correct ones in difficult tasks. The efforts of such high test anxious subjects could at such instance, be described as being diffused, and incapable of solving difficult task. This view is shared with Spence and Spence (1966).

The effectiveness of two cognitive strategies in reducing test-anxiety and promoting academic performance were studied.

Also the results revealed that study skill training improved academic performance of the subjects. This is because the study skill training programme helped the subjects to re-examine and restructure their study pattern to a more productive pattern that met their academic demands.

Thus, being better equipped, they were more relaxed to face the evaluative situations and improve on their academic performance.

Concept mapping strategy was also found to have a reductive effect on subjects' test-anxiety level. In the researcher's opinion concept mapping has a visual way of stressing conceptual organisation and integration that leave a lasting effect on the subjects' memory; it therefore acts as memory support technique. The subjects being exposed thus to the rudiments of biology were able to overcome the 'reality based' fear they had for this science subject with vast curriculum. This view agrees with those of Cliburn Jnr. (1987), and Novak *et al.* (1983) who contended that concept maps when used as advance organisers and pre-instructional strategy present the subjects with relevant background for subsequent unit of study. However, they did not go further to test its effectiveness on test-anxiety reduction. Alaiyemola (1988), on the other hand who tested it on test-anxiety reduction did not find it effective.

Concept mapping was also found to improve the experimental subjects' academic performance. This can be attributed to its ability to promote integrative reconciliation of concepts and reduce the tendency of 'rote' learning and its concomitant learning of concepts in isolation. Concept mapping thus equipped the subjects with an effective means of studying a highly conceptual subject like Biology. The finding agrees with that of Wicklegnen (1978), Novak (1983), Alaiyemola (1988) and Okebukola (1994).

Furthermore, the comparism of the effects of study skill training, and concept mapping on test-anxiety levels of the subjects as shown in Table 4.9, revealed that, although study skill training has a slightly higher mean score, for test-anxiety, than concept mapping, there is no significant difference between the effects of the two strategies. However, the comparism of the effects of the two strategies on academic performance of the subjects, as shown in Table 4.10, revealed a significant difference. Concept mapping with a mean academic performance of 62.33 improved the subjects' academic performance more than study skill training sessions with mean score of 53.17. Although both strategies are cognitive, study skill training is a more general

approach to the subjects' academic problems, whereas concept mapping strategy on information processing model of learning exposed the subjects to integrative encoding of concepts, thereby enhancing long term memory and retrieval modes. The visual quality of concept maps also helped the subjects to consolidate on learned concepts. They also acted as internal memory aid that permitted improved information processing. This view agrees with that of Sieber *et al.* (1970), and Wicklegnen (1979), who contended that learning takes place when associations between nodes are strengthened.

In addition, the combined strategy of study skill training with concept mapping when used as a therapy for reducing test-anxiety and promoting academic performance, was found to be significantly effective. Tables 4.11, 4.12, 4.13 and 4.14 reveal significant differences between the effects of the single treatments of study skill training and concept mapping, and the combined strategy of study skill training with concept mapping. Study skill training in the combined therapy provided the subjects with study counselling needed for improved academic baheviour and contributed to the elimination of the cause of test-anxiety - 'reality based fear;' while the concept mapping strategy in the combined therapy helped to sensitise the subjects on the demands of Biology subject, taught them consolidation of knowledge through integration of related concepts; it thus helped to reduce the subjects' test-anxiety through the elimination of the 'fear of the unknown.'

However the analysis of variance of the post test scores of the three therapies and the control for test-anxiety and academic performance pulled together, as shown in Table 4.17, revealed high significant difference between the treatments at 0.01 and 0.05 levels of significance. The DMRT analysis shown in Table 4.18 revealed that concept mapping and the combined strategy of study skill training with concept mapping strategy, had the most significant effect on the subjects' test anxiety and academic performance. Since the effects of these two strategies are not significantly different, as shown by the DMRT, it therefore follows that they can be used interchangeably for the reduction of test-anxiety and improvement of academic performance among Biology students.

On the other hand, the analysis of the pre- and post academic performance scores of the control group which revealed significant difference between the two sets of scores, can be attributed to human element factor and the nature of the topics taught during the research period. The intrinsic desire to improve on their poor academic performance could have prompted them to work harder. Also they might have found the topics taught during this period easier to understand or more interesting. However, the experimental group was also exposed to these same possible improvement factors; since the tone of the results was not affected by this seeming improvement in the academic performance of the control group, it could be explained that their high anxiety level which did not improve (because no treatment was given), did not allow them to perform as well as the experimental groups that received treatments. Also, since the pre-test anxiety levels and academic performance scores of the control and the experimental groups were *not significantly different* (Appendix 8), *it can be acclaimed that the differences that occurred at* the end of the research were as a result of the treatments given.

5.3 Summary

This study was aimed at determining the effects of study skill training, and concept mapping strategy on test-anxiety and academic performance of Biology students, with the view of evolving the best suitable way of reducing test-anxiety and improving their academic performance. The subjects for the study consisted of the 139 SS III Biology students of F.G.G.C., Zaria. The sample was obtained from the rating of the subjects' scores in the test-anxiety and achievement pre-tests. The subjects that scored 8 and above on the anxiety scale and less than 40% in Biology achievement test constituted the sample for the study. The experimental and control groups were determined through random sampling.

The experimental groups were then exposed to 6 weeks therapies comprising of 12 sessions of 70 minutes each. The therapies used were study skill training, concept mapping strategy, and combined strategy of study skill training with concept mapping. After 6 weeks

therapy, the subjects were rated again on the test-anxiety scale to determine their post test-anxiety levels. The post Biology achievement test was administered based mainly on what was learnt during the 6 weeks of therapy. The scores obtained represented the post achievement scores.

t-test and analysis of variance with DMRT were used to analyse the data obtained. The results obtained are:

(a) Academic performance in Biology is significantly negatively correlated with test-anxiety.

(b) There was significant difference in the test-anxiety levels of experimental and control groups after:

(b-1) study skill training sessions.

(b-2) concept mapping sessions.

Thus the null hypothesis of no significant difference is rejected.

(c) There was significant difference in the academic performance of experimental and control groups after:

(c-1) study skill training sessions;

(c-2) concept mapping strategy.

Thus the null hypothesis of no significant difference is rejected.

(d) There was no significant difference between the test-anxiety levels of subjects exposed to study skill training and those exposed to concept mapping strategy. Thus, the null hypothesis of no significant difference is retained.

(e) There was significant difference between the academic performance of subjects exposed to study skill training and those exposed to concept mapping. Thus the null hypothesis of no significant difference is rejected.

(f) There was significant difference in the test-anxiety levels of subjects exposed to the combined therapy of study skill training with concept mapping, and those exposed to:

(f-1) study skill training session, or

(f-2) concept mapping strategy.

(g) There was significant difference in the academic performance of subjects exposed to the combined therapy of study skill training with concept mapping, and those exposed to either:

(g-1) study skill training, or

(g-2) concept mapping strategy.

(h) There was no significant difference between the general effect of concept mapping strategy and the combined therapy of study skill training with concept mapping, on subjects test-anxiety and academic performance.

5.4 Limitation of the Study

The research experienced a little delay at the unset when the investigator fell ill. This brought about a change in the level of class sed as target poplation becase the SS II students that were intended or the study passed on to SS III. This change however did not affect the result obtained.

5.5 Recommendations

(a) Concept mapping strategy should be used by Biology teachers and students for integrative teaching/learning of Biology concepts, in order to promote learning and reduce test-anxiety. This idea can be disseminated during workshops and seminars.

(b) The inclusion of concept mapping in the Biology working syllabus under the activities to be carried out by students, could go a long way in popularising its use.

(c) Study skill counselling should be integrated with concept mapping strategy by Biology teachers as a means of reducing test anxiety and promoting academic performance.

(g) There was significant difference in the academic performance of subjects exposed to the combined therapy of study skill training with concept mapping, and those exposed to either:

(g-1) study skill training, or

(g-2) concept mapping strategy.

(h) There was no significant difference between the general effect of concept mapping strategy and the combined therapy of study skill training with concept mapping, on subjects test-anxiety and academic performance.

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(c) Study skill counselling should be integrated with concept mapping strategy by Biology teachers as a means of reducing test anxiety and promoting academic performance.

5.6 Implication for Further Research

(a) A replication of this study using other science based subjects for a more meaningful generalisation to be made.

(b) A similar study can be carried out for a longer period of time in order to assess the long term effect of the therapies.

Such studies are desirable because the information generated will be useful to education policy makers in evolving adequate methods of teaching science-based subjects.

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APPENDIX I

ANXIETY TEST

Name of School _____ Class _____

FOR OFFICIAL USE ONLY

Test Scores: _____
Teacher Control: _____
Teacher's Qualification _____
Teaching Experience: _____
ClassParticipation:_____
Attitude Score: _____

Instruction

The words below could describe how you feel about school science. Read through the list of words and underline those which describe how you generally feel about science. You may underline as many or as few as you wish.

Absorbed	Afraid(+)	Aimless	Ambitious	Annoyed
Aware	Bored	Calm(-)	Careless	Cautious
Challenged	Cheerful(-)	Cheated	Comfortable	Confused
Contented(-)	Creative	Curious	Dedicated	Desperate(+)
Disappointed	Efficient	Entertained	Excited	Fearful (+)
Fortunate	Frightened(+)	Happy(-)	Hopeless	Impatient
Incapable	Inspired	Interested	Joyful(-)	Lazy
Loving(-)	Miserable	Misplaced	Nervous	Organized
Over loaded	Panicky(+)	Pleasant(-)	Pleased	Productive
Pushed	Refreshed	Regretful	Rewarded	Satisfied
Secure(-)	Serious	Shaky(+)	Steady(-)	Tense(+)
Terrified(+)	Thoughtful(-)	Upset(+)	Weary	Worried(+)

APPENDIX 2

BIOLOGY ACHIEVEMENT PRE-TEST

INSTRUCTION: Read each question carefully and choose **one** correct response from options A-E. Shade the corresponding alphabet on the answer sheet provided. **Do not** shade more than one response for an answer.

1. Which of the following statements about the cell is not true?

   (a) The cell is the basic unit of plants and animals.
   (b) Certain animals consist of only one cell
   (c) Most common organisms are multicellular
   (d) Volvox and Hydra are unicellular organisms.

2. All the following statements are correct except.

   (a) Osmosis is the movement of molecules from a hypotonic solution through a *differentially permeable membrane.*

   (b) Absorption of water by root hairs is an example of a process that occurs by osmosis.

   (c) Gaseous exchange in the lungs is an example of an osmotic process.

   (d) Plasmolysis may result in the wilting or death of plants.

   (e) Turgidity helps plants to stand erect and firmly.

3. One of the properties of cells responsible for the continuity of species is:

   (a) growth
   (b) reproduction
   (c) nutrition
   (d) excretion
   (e) movement.

4 Which of the following structures or organelles is used for the elimination of liquid waste in paramecium?

   (a) Food vacuole
   (b) Oral groove
   (c) Anal pore
   (d) Contractile vacuole
   (e) Nucleus

5. The function of chlorophyll in the leaf during photosynthesis is.

   (a) Absorption of water
   (b) Absorption of carbon dioxide
   (c) Release of oxygen

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(d) Absorption of light energy
(e) Release of energy.

6. Anaerobic respiration differs from aerobic respiration in that anaerobic respiration.

(a) Release less energy
(b) Breaks glucose down completely
(c) Produces less alcohol.
(d) Uses up more oxygen
(e) Releases more energy.

7. Which of the following substances is produced during the diminution of protein by the liver?

(a) Amino acid
(b) Glycogen
(c) Urea
(d) Glycerol
(e) Mineral salts.

8. All the following animals have endoskeleton except:

(a) Pigeon
(b) Lizard
(c) Grasshopper
(d) Tilapia
(e) Goat.

9. The axial skeleton in mammals is composed of the

(a) Skull
(b) spine
(c) limbs and girdles
(d) Skull and limbs
(e) Skull and spine

10. A vertebra that has a long neural spine is likely to be a:

(a) Sacral vertebra
(b) Lumbar vertebra
(c) Thoracic vertebra
(d) Cervical vertebra
(e) Axis

11. The elbow joint is an example of a :

(a) ball and socket joint
(b) hinge joint
(c) axial joint
(d) gliding joint (e) pivot joint

12. Which of the following is not one of the functions of the mammalian skeleton?

(a) Support of body organs
(b) Protection of body organs
(c) Respiration
(d) movement of body parts
(e) Synthesis of some mineral salts

13. Iron is needed in plants for

(a) the formation of chlorophyll
(b) protein synthesis
(c) formation of cell sap
(d) Nuclear division
(e) Neutralisling alkaline soils

14. The part of spirogyra directly involved in the manufacture of food is

(a) Pyrenoid
(b) mucilage
(c) nucleus
(d) chloroplasts
(e) cytoplasm

15. The process whereby water in the spongy layer of the leaf evaporates into the air outside through the stomata is

(a) excretion
(b) Osmosis
(c) transpiration
(d) capillarity
(e) root pressure

16. Carbohydrate is manufactured in plants by a process called

(a) oxidation
(b) photosynthesis
(c) respiration
(d) assimilation
(e) Chemosynthesis

17. Which of the following statements is false?

(a) The crop is a modified part of the bird's gut
(b) The appendix in a man's gut performs a very important digestive function
(c) Ruminants have four compartments making up their stomach.
(d) Digestion of food starts in the mouth and ends in the ileum in most mammals.
(e) The small intestine is the longest part of the mammalian alimentary canal.

18. The release of energy in the tissues of the body through the breakdown of carbohydrates is described as.

(a) Breaking
(b) digestion
(c) cell respiration
(d) hydrolysis
(e) anaerobic respiration

19. Fermentation is caused by

(a) lack of oxygen
(b) presence of carbon dioxide
(c) activity of micro-organisms
(d) lack of carbondioxide
(e) Lack of micro-organisms

20. Which of the following food substances contain just these elements carbon, oxygen, hydrogen and nitrogen?

(a) sugar
(b) fat
(c) starch
(d) protein
(e) oil

21. Which of the following is the best definition of respiration?

(a) The oxidation of carbohydrates to produce carbondioxide and water only.
(b) A series of chemical changes whereby food is oxidised through the action of enzymes to release energy.
(c) The break down of food substances to release energy and oxygen.
(d) The breathing in of oxygen and the breathing out of carbon dioxide.
(e) The building up of food substances using energy.

22. The source of energy in all living organisms can be traced back to

(a) Plants
(b) the sun
(c) water
(d) carbon dioxide
(e) carbohydrates.

23. Energy used during exercise is derived from

(a) stored glycogen
(b) stored amino acid
(c) lipids
(d) the blood
(e) the heart.

24. In human beings energy is stored in the form of

(a) Nicotinic acid
(b) Adenosine diphosphate
(c) Adenosine triphosphate
(d) Glycogen
(e) Adipose tissue

25. The end product of glycolysis is

(a) Trios suger
(b) oxaloacitic acid
(c) succinic acid
(d) citric acid
(e) pyruvic acid.

26. The process by which light energy splits water into (H^+) and (OH^-) during the light stage of photosynthesis is called.

(a) Chemosynthesis
(b) photosynthesis
(c) photolysis
(d) biophysics
(e) chlorosynthesis.

27. Which of these is not an excretory product?

(a) Urea
(b) ammonia
(c) amino acid
(d) carbon dioxide
(e) sweat.

28. Which of these is not an excretory organ?

(a) the kidney
(b) the skin
(c) the lings
(d) stomata
(e) Anus

29. Which of the following statements about transport in plants is false?

(a) Materials are transported via the vascular tissues.
(b) Mineral salts diffuse readily into the roots.
(c) Water from the soil enters the root hairs and the root contex by osmosis.
(d) Water reaches the top of high trees through the transpiration stream
(e) Food is translocated by active transport in plants.

30. All the following statements about transport in mammals are true except.

(a) Blood usually passes from arteries to other parts of the body
(b) Veins usually carry blood back to the heart.
(c) deoxygenated blood from all body parts enters the heart through the left auricle.
(d) Digested food from the small intestines passes into the liver through the hapatic portal vein.
(e) lymphatics are as numerous as the blood capillaries and ike veins have valves.

31. The respiratory organ in insects is the

(a) Lung
(b) lung book
(c) tracheal system
(d) gills
(e) tracheale system.

32. Which of the following substances releases the greatest amount of energy during aerobic respiration?

(a) Glucose
(b) fat
(c) protein
(d) starch
(e) vitamins

33. Which of the following elements is essential for chlorophyll formation?

(a) Magnesium
(b) Manganese
(c) Sulphur
(d) Copper
(e) Potassium

34. Which of the following is <u>not</u> a micronutrient

(a) copper
(b) zinc
(c) molybdenum
(d) calcium
(e) Boron

35. The reagent used to test for the presence of fat in a food substance is:

(a) Osmic acid
(b) Benedicts solution
(c) Fehling's solution
(d) Iodine
(e) Millon's reagent

36. Which of the following is a stem tuber

(a) Onion
(b) cassava
(c) carrot
(d) yam
(e) sweet potato

37. The following statements are true of vegetative propagation of plants except:

(a) It is the propagation of plants using the vegetative parts.
(b) Vegetative propagation gives rise to variety.
(c) Vegetative propagation maintains the characteristics of the species.
(d) There is perpetuation of family disease in vegetative propagation
(e) Vegetative propagation of plants is economical.

38. Which of the following is not a vegetative part of a plant?

(a) Fruit
(b) leaf
(c) stem
(d) bud
(e) root.

39. Which of the following is not a genetically transmitted trait?

(a) Baldness
(b) albinism
(c) sixth finger
(d) tribal marks
(e) tongue rolling

40. The following statements are true of mitosis <u>except</u>.

(a) Takes place in the somatic cells
(b) Results in growth
(c) There is mixing of chromatic materials
(d) Takes place in four stages
(e) Results in the formation of two diploid cells

41. Which of the following is described as character determinants?
(a) Chromosomes
(b) Chromatids
(c) Chiasma
(d) Genes
(e) Centromeres

42. In mitosis the stage at which the chromatic threads arrange themselves at the equater of the spindle is described as:

(a) Telophase

(b) Prophase
(c) Metaphase
(d) Anaphase
(e) Chiaphase

43. Which of the following ecological instruments will you use to measure the volume of oxygen in a habitat?

(a) Thermometer
(b) Manometer
(c) Hygrometer
(d) Barometer
(e) Anemometer.

44. In a food chain of aquatic habitat which of the following organisms will be described as a secondary consumer?

(a) tadpole
(b) lizard
(c) *spirogyra*
(d) mosquito larva
(e) snake

45. Which of the following instruments will not be used in the study of terestral habitat?

(a) Thermometer
(b) Barometer
(c) pH meter
(d) Hygrometer
(e) Secchidisc.

46. All the following are water borne diseases except:

(a) Malaria
(b) Typhoid
(c) Cholera
(d) Diarrhoea
(e) Schistosomiasis

47. The atmospheric nitrogen is replenished by a group of micro-organisms called

(a) Nitrogen-fixing bacteria
(b) Denitrifying bacteria
(c) Putrefying bacteria
(d) *Root nodule bacteria*
(e) Azotobacter

48. Which of the following groups of plant is least developed?

(a) Angiosperus
(b) Bryophytes

(c) Pteridophytes
(d) Thallophytes
(e) Gymnosperms.

49. The cells responsible for secondary thickening in plants are the

(a) Cambial cells
(b) Phloem cells
(c) xylem cells
(d) pericycle
(e) sclerenchyma cells.

50. Which of the following is not a supporting tissue in plants?

(a) Parenchyma
(b) Cambium
(c) Collenchyma
(d) Schlerenchyma
(e) Wood xylem.

APPENDIX 3

BIOLOGY ACHIEVEMENT POST-TEST

INSTRUCTION: Read each question carefully and choose one correct response from options A-E. Shade the corresponding alphabet on the answer sheet provided. Do not shade more than one response for an answer.

1. Which of the following is NOT present in the nucleus of a cell?

   A. Chromosones
   B. Mitochandrion
   C. Nucleolus
   D. Genes
   E. Nucleoplasm

2. Which of the following plants does NOT possess vascular tissues?

   A. Grass
   B. Hibiscus
   C. Liverwart
   D. Tridox
   E. Water leaf

3. The organelles that synthesize carbohydrates in plant cells are:

   A. Chromoplasts
   B. Ribosames
   C. Mitochandria
   D. Chloroplasts
   E. Leucoplasts

4. The translocation of feed materials in plants takes place in the

   A. Xylem
   B. Cambium
   C. Phloem
   D. Caecum
   E. Sclerenchyma

5. Which of the following does not belong?

   A. Gizzard
   B. Alveolus
   C. Crop
   D. Caecum
   E. ileum

6. The part of the alimentary canal of a bird where grinding of maize occurs is

   A. Crap

B. Stomach
C. Gizzard
D. Cloaca
E. Rectum

7. The enzyme that coagulates the protein in milk is

A. Pepsin
B. Trypsin
C. Anylase
D. Rennin
E. Ptyalin

8. The organ located in the mammalian abdominal cavity just below the diaphragm and lying on top of the stomach is the

A. bladder
B. intestine
C. liver
D. pancreas
E. spleen

9. Which of the following processes takes place in the ileum of a human being?

A. Swallowing of food
B. Secretion of saliva
C. Absorption of water
D. Absorption of digested food
E. Secretion of bite

10. The vegetarian habit of the tadpole is associated with its possession of

A. external gills
B. a streamlined body
C. a long tail with a fin
D. a large head with a sucker
E. a long coiled intestine.

11. Which mammalian teeth is structurally adapted for tearing flesl

A. Molar
B. Incisor
C. Pre-molar
D. Canine
E. Carnassial

12. Which of the following explains what happens to excess amino acid in the body of mammals? It is:

A. Stored in the liver
B. broken down in the liver

C. Converted into urea in the kidney
D. Stored as bile in the liver
E. Stored in the blood.

13. Which of the following is NOT a characteristic of respiratory surfaces?

A. Sparsely vascularised
B. Moist
C. Thin walled
D. Permeable
E. Have large surface area to volume ratio

14. The respiratory organ found in the cockroach is the

A. air sac
B. trachea
C. lung beole
D. Lung
E. gill

15. Which of the following organisms and organs of gaseous exchange are NOT appropriately matched?

A. Earthworm - body surface
B. Fish - gills
C. Adult toad - gills
D. Grasshopper - trachea
E. Lizard - lungs

16. Which of the following structures of the leaf contain air?

A. Guard cell
B. Palisade layer
C. Intercellular space
D. Vascular bundle
E. Upper epidermis

17. Breathing movement in mammals is accompanied by regular movements of the diaphragm and the

A. Intercostal muscles
B. Vertebral column
C. Clavicle
D. Pleural cavity
E. Floating ribs

18. Which of the following terms is used to describe the breathing movement during which the ribs are drawn upwards and outwards?

A. Expiration
B. Oxygenation
C. Inspiration
D. Anaerobic respiration
E. Internal respiration

19. The aerobic stage of cellular respiration takes place in the

A. Cytoplasm
B. Nucleus
C. Protoplasm
D. Mitochandrian
E. Ribosome.

20. The movement of gases between organisms and their surroundings on the basis of a concentration gradient is

A. Osmosis
B. Turgidity
C. Plasmolysis
D. Diffusion
E. cohesion

21. Which of the following structures functions as an excretary system found in flat worms?

A. Contractile vacuole
B. Nephridium
C. Flame cell
D. Malpighean tubule
E. Kidney

22. The major functions of the kidney are

A. Deamination and detoxication
B. Excretion and osmoregulation
C. Transportation and osmoregulation
D. Deoxygenation and detoxication
E. Perspiration and excretion

23. Which of the following are components of glomerular filtrate?

A. All the components of blood except mineral salts
B. Water and salt only
C. All the components of blood except plasma protein and cells
D. Plasma proteins, red and white blood cells.
E. Blood cells, amino acids, salts and nitrogenous wastes.

24. The mechanism by which useful materials in the glomerular filtrate are taken back into the blood is known as

A. Filtration
B. Reabsorption
C. Haemolysis
D. Osmosis
E. Dialysis

25. The increase in width of blood vessels in the mammalian skin at high temperature is known as

A. Vasodilation
B. Sweating
C. Vasoconstriction
D. Shivering
E. Evaporation

26. Excretary products in mammals do not include

A. Urea
B. Mineral salts
C. Carbon dioxide
D. Ammonia
E. Water

27. Carrying out an ecological investigation of a habitat includes all the following, except

A. Sampling area
B. Collecting specimens
C. Identifying organisms
D. Measuring abiotic factors
E. Regulating light intensity

28. Which of the following is correct of a community?

A. A group of organisms found in several habitats
B. Populations of plants found in several habitats
C. Many populations of different species
D. Population of the same species living in the same habitat.
E. Human population in a locality

29. The climax of succession in a given habitat is defined as the plants and animals which

A. Appear first in the habitat
B. Dominate during the transition
C. Become permanent in the habitat
D. Climb tall trees in the environment
E. Find the habitat's climate unbearable

30. When large numbers of organisms share space and resources the result is

A. Immigration
B. Commensalism
C. Symbiosis
D. Extinction
E. Competition

31 The association between organisms in which both organisms benefit from one another is known as

A. Parasitism
B. Saprophytism
C. Predation
D. Mutualism
E. Epihytism

32. The number of organisms of different species in a plant population can be determined by using

A. Quadrant
B. Transect
C. Map
D. Pooter
E. Auxanometer

33. The topographic factor in a habitat refers to the

A. Type of organisms in the habitat
B. Sixe of the Soil particles
C. Depth of the water table
D. Structure of the earth's surface
E. Climate of the habitat

34. The tolerance of an organism refers to the

A. Sum total of its adaptive features
B. Resistance of the organism to predators
C. Ability to accommodate other organisms in its territory
D. Number of males a female organism can pair up with during courtship
E. Survival range of an organism under unfavourable ecological conditions.

35. Which of the following correctly defines the term species?

A. Organisms that can interbreed
B. Animals in the same habitat
C. Special animals in a forest reserve
D. Organisms that belong to the same food chain
E. Plant and animal community in a habitat

36. Which of the following is NOT an adaptive feature of plants found in arid lands?

A. Long roots for absorption of water from deep soil level
B. Succulent stems which store water
C. Presence of thin bark
D. Leaves reduced to spines
E. Stems containing chlorophyll

37. Which of the following is NOT released during the process of decomposition?

A. Ammonia
B. Carbon dioxide
C. Heat
D. Hydrogen sulphide
E. Oxygen

38. Which of the following activities is likely to increase the amount of carbon dioxide in the atmosphere?

A. Photosynethesis
B. Transpiration
C. Combustion
D. Denitrification
E. Diffusion

39. The process whereby dead organic materials are broken down into simple substances is referred to as

A. Putrefaction
B. Nitrogen-fixation
C. Denitrification
D. Chemosynthesis
E. Anabolism

40. One of the problems facing conservation of life in Nigerian game reserves is

A. Migration
B. Emigration
C. Pollution
D. Poaching
E. Immigration

41. Equal volumes of Fehling's solutions A and B were added to a food substance and on heating, brick-red precipitate was formed. This indicates that the food substance contained.

A. Proteins
B. Reducing sugar
C. Starch
D. Fatty acid
E. Amino acid

42. Which of the following element is not a micro nutrient required by plants?

A. Potassium
B. Iron
C. Magnesium
D. Manganese
E. Phosphorus

43. During photosynthesis energy obtained from sunlight is used for

A. Splitting water molecules into oxygen and hydrogen ions
B. Opening and closing of stomata
C. Reducing ATP and ADP
D. Raising the temperature of water and carbon
E. Increasing the rate of water uptake

44. Which of the following statements about the effect of soils on vegetation is NOT true?

A. The canopy of the tropical forest makes the soil too moist for dense undergrowth
B. The pH of the soil determines the variety of plants growing in a habitat
C. Rocky soils are most unlikely to encourage the growth of trees
D. Water-logged soils are very favourable for maixe growth
E. Water-logged soils cannot sustain the growth of mesophytes

45. A hygrometer is used for measuring

A. Relative humidity
B. Specific gravity
C. Light intensity
D. Turbidity
E. Wind speed

46. Which of the following is used for the collection of small insects from soil, leaf litter and crevices?

A. Quadrant
B. Pooter
C. Sweep net
D. Drag net
E. Butterfly net

47. Which of the following is NOT needed by green plants in the aquatic habitat for survival?

A. Chlorophyll
B. Water storage tissue
C. Sunlight
D. Carbon dioxide
E. Stomata

48. Which of the following best described a food web?

A. A linear feeding relationship among organisms in the same community.
B. A cob-web like food relationship among producers
C. a feeding relationship comprising of carbohydrates, fats, oil and protein
D. A complex feeding relationship consisting of interrelated food chain
E. A community comprising of producers, consumers and decomposers.

49. The amount of moisture found in various samples of reshly dung up soil can indicate

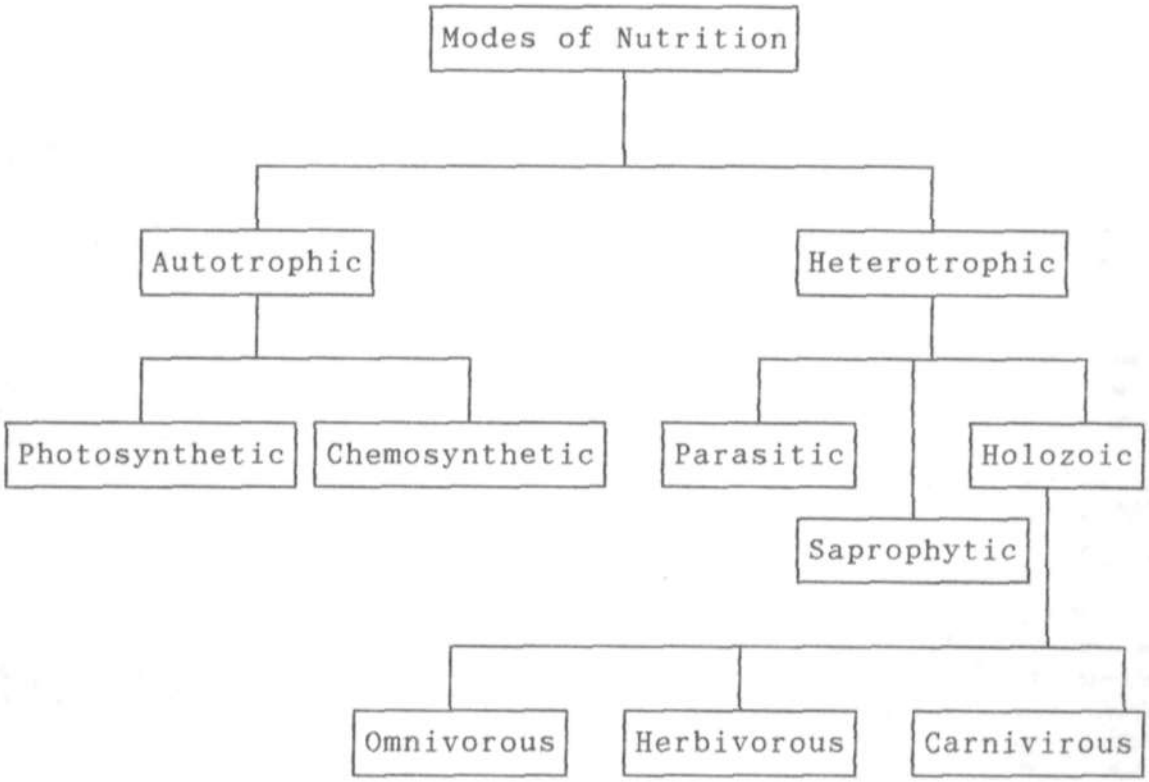
A. Variety of organism in the soil
B. Water-retaining capacity of the soil
C. Percentage of mineral salts in the soil
D. Percentage of trace elements in the soil
E. Amount of organic materials in the soil.

50. If 80 grasshoppers are found in a field with a total area of 100 m^2, what is the population density of grasshoppers in the field?

A. 0.08 per m^2
B. 0.8 per m^2
C. 80 per m^2
D. 100 per m^2
E. 8000 per m^2

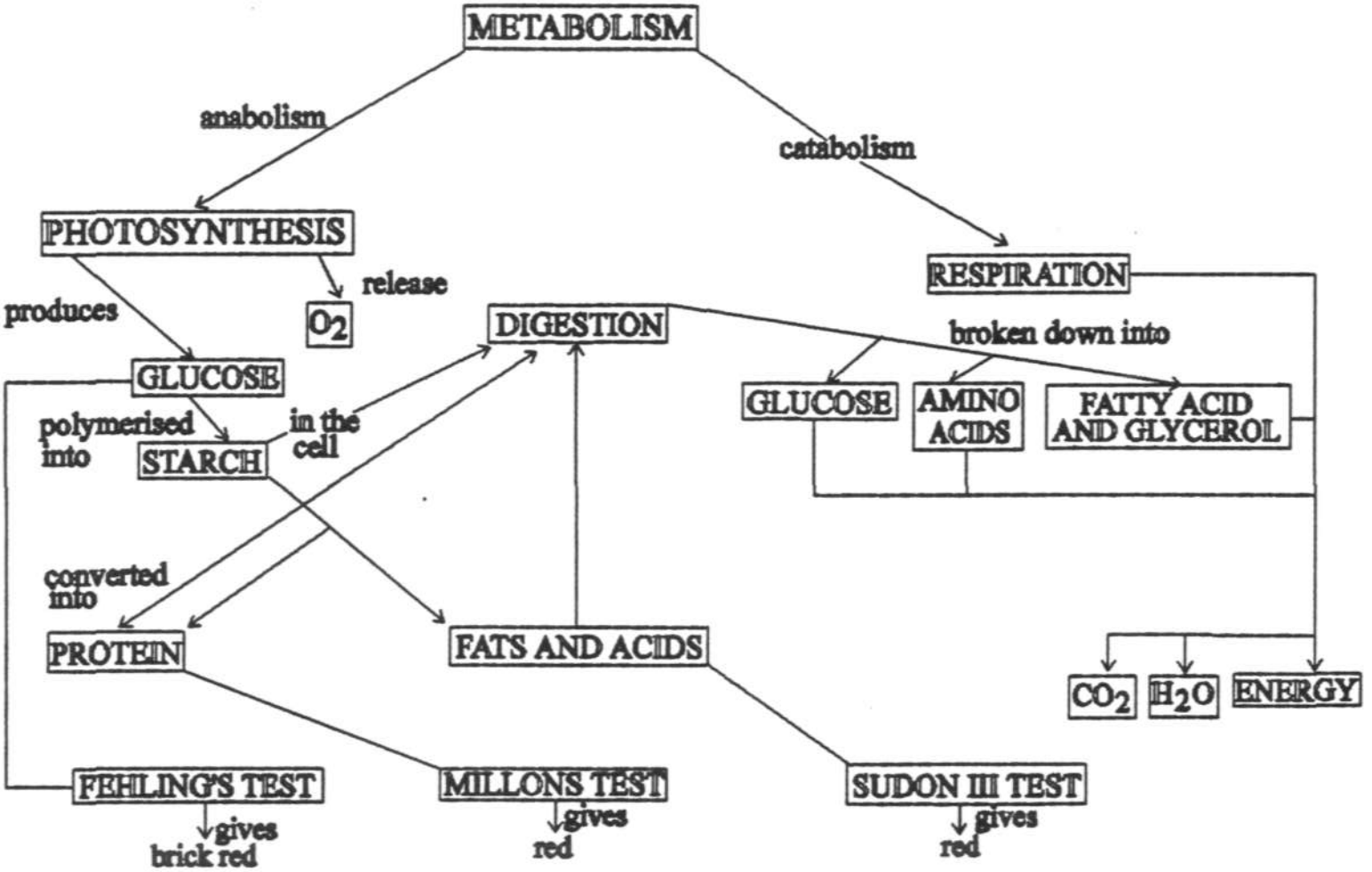
APPENDIX 4

CONCEPT MAP OF MODES OF NUTRITION



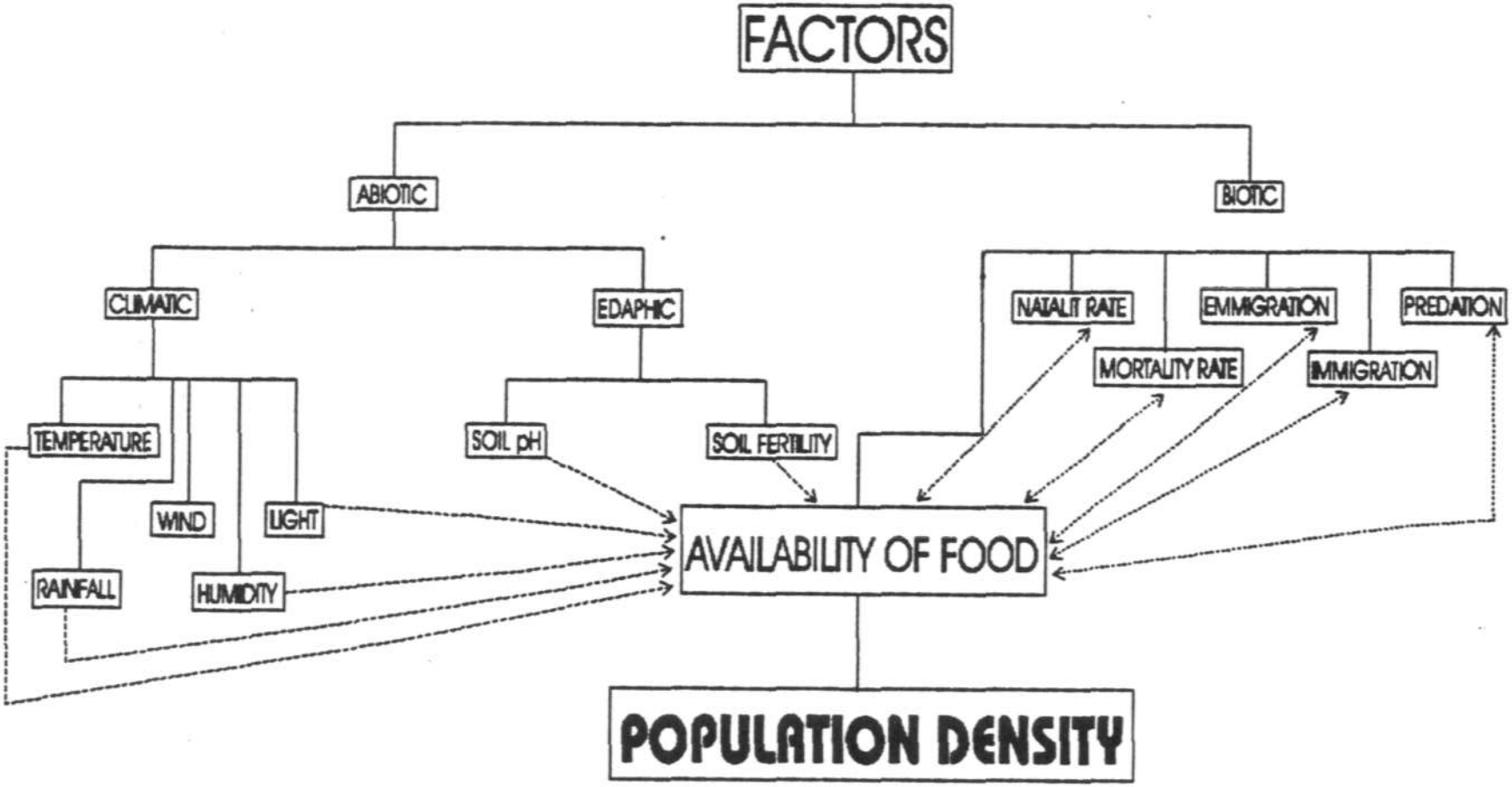
APPENDIX 5

CONCEPT MAP OF METABOLISM



APPENDIX 6

CONCEPT MAP OF FACTORS THAT AFFECT POPULATION DENSITY



APPENDIX 7

THE RAW DATA

EXPERIMENTAL GROUP												CONTROL GROUP			
E1				E2				E3				C			
Anxiety		Achievement		Anxiety		Achievement		Anxiety		Achievement		Anxiety		Achievement	
Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test
12	4	38	56	17	11	30	62	18	8	34	66	15	14	30	35
13	11	34	48	14	5	34	70	11	4	38	80	10	9	38	44
17	11	30	48	15	13	36	62	14	8	36	68	15	12	35	40
20	14	35	50	16	12	38	60	15	8	30	54	11	12	38	45
14	10	38	58	17	12	32	56	15	7	35	66	18	15	30	35
11	7	36	60	11	8	36	60	14	8	32	62	10	11	38	50
12	8	38	54	13	9	34	64	13	7	36	65	13	8	36	60
13	14	30	34	14	9	34	62	16	5	38	72	17	15	30	40
11	8	35	54	11	7	38	68	14	7	34	70	14	15	38	38
11	7	38	50	11	5	36	64	14	8	30	65	16	13	32	48
15	8	36	60	12	8	38	62	10	4	39	85	12	12	38	38
15	9	36	56	14	10	34	58	12	5	38	78	13	11	38	34

APPENDIX 8

T-TEST ANALYSIS OF THE PRE-SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS

t-test of pre-test anxiety levels of study skill experimental group (E1) and the pre-test anxiety level of the control group.

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Experimental groupl (E1)	12	13.67	2.74					
				0	2.69	0.55	0	22
Control group (C)	12	13.67	2.64					

$\alpha = 0.05$ Tcrit = 1.72

There is no significant difference between the anxiety levels of the two groups.

t-test of pre-academic performance scores of study skill experimental group (E1) and the control group (C).

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Experimental group (E1)	12	35.33	2.84					
				.25	3.22	0.66	0.19	22
Control group (c)	12	35.08	3.55					

$\alpha = 0.05$

There is no significant difference in the academic performance scores of the two groups.

t-test of pre-anxiety levels of concept mapping experimental group (E2) and control group (C).

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Experimental group (E2)	12	13.75	2.22					
				.08	2.44	0.49	0.084	22
Control group (c)	12	13.67	2.64					

α 0.05

There is no significant difference in the anxiety levels of the two groups.

t-test of pre-academic performance of concept mapping experimental group (E2) and control group.

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Experimental group (E1)	12	35	3.10					
				-0.8	3.34	0.68	-0.07	22
Control group (c)	12	35.08	3.55					

∝ 0.05

There is no significance difference in the academic performance of the two groups.

t-test of the pre-anxiety levels of the combined strategy experimental sub-group (E3) and the control (C).

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Combined strategy (E3)	12	13.83	2.17					
				0.16	2.42	0.49	0.17	22
Control group (c)	12	13.67	2.64					

∝ 0.05

There is no significant difference in the anxiety levels of the two groups.

t-test of pre-academic performance scores of the combined strategy experimental sub-group (E3) and the control (C).

Variables	Number of cases	Mean	Standard deviation	Differences in means	Standard deviation	Standard error	T-value	Degree of freedom
Combined strategy (E3)	12	35	3.10					
				-.08	3.34	0.68	-0.06	22
Control group (c)	12	35.08	3.55					

∝ 0.05.

There is no significant difference between the academic performance scores of the two groups.

APPENDIX 9

MEASURE OF THE CLOSENESS OF THE RELATIONSHIP BETWEEN ACHIEVEMENT AND TEST ANXIETY

Groups	Correlation coefficient (r)	DF	r-value	Significance level
E1	-0.793	22	0.5169	**
E2	-0.789	22	0.5169	**
E3	-0.058	22	0.5169	**
C	-0.651	22	0.5169	**
All the groups pooled	-0.827	94	0.2669	**

** = Highly significant (P=0.01).

Appendix 10: Relationship between Test Anxiety and Achievement

